

Herp.
QL
668
.E2
R53
1994

e to the Frogs

Iquitos Region, Amazonian Peru



Reticulated Poison Frog

Dendrobates reticularius

LILY O. RODRÍGUEZ
AND
WILLIAM E. DUELLMAN

Herp.

QL

668

.E2

R53

1994

Museum of Comparative Zoology Library
Harvard University

A copy of the *Guide to the Frogs of the Iquitos Region, Amazonian Peru* may be obtained by writing to:

Publications Secretary
Natural History Museum
The University of Kansas
Lawrence, Kansas 66045, USA

The charge for each copy of the Guide is \$19.95 U.S. currency, plus \$1.50 for postage and handling. (Overseas postage is \$3.00.) MasterCard and VISA are accepted. To order by phone, call 913-864-4540.

A free copy of our most recent Catalogue of Publications may be obtained from the above address.

THE UNIVERSITY OF KANSAS
NATURAL HISTORY MUSEUM

SPECIAL PUBLICATION No. 22
December 1994

**GUIDE TO THE FROGS
OF THE
IQUITOS REGION, AMAZONIAN PERU**

BY
LILY O. RODRÍGUEZ
AND
WILLIAM E. DUELLMAN

PUBLISHED BY
ASOCIACIÓN DE ECOLOGÍA Y CONSERVACIÓN,
AMAZON CENTER FOR ENVIRONMENTAL EDUCATION AND
RESEARCH,
AND
NATURAL HISTORY MUSEUM, THE UNIVERSITY OF KANSAS

LAWRENCE, KANSAS
1994

UNIVERSITY OF KANSAS PUBLICATIONS, NATURAL HISTORY
MUSEUM

Editor: Linda Trueb

SPECIAL PUBLICATION No. 22

pp. i-ii, 1-80

Plates 1-12

Published December 1994

ISBN 0-89338-047-4

MCZ
LIBRARY

MAY 16

HARVARD
UNIVERSITY

NATURAL HISTORY MUSEUM
THE UNIVERSITY OF KANSAS
LAWRENCE, KANSAS 66045
USA

Front cover: *Dendrobates reticulatus*. Photograph by W. W. Lamar
Cover and publication design by Linda Trueb

© Natural History Museum, The University of Kansas

PRINTED ON ACID-FREE, RECYCLED PAPER
BY
UNIVERSITY OF KANSAS PRINTING SERVICE
LAWRENCE, KANSAS

CONTENTS

BIOGRAPHICAL SKETCHES	iv
PREFACE	v
INTRODUCTION	1
BIOLOGY OF FROGS	1
HOW TO USE THIS GUIDE	2
Names	4
Terminology	5
GUIDE TO THE FROGS	11
TOADS (FAMILY BUFONIDAE)	11
POISON ARROW FROGS (FAMILY DENDROBATIDAE)	15
TREEFROGS (FAMILY HYLIDAE)	20
Egg-brooding Frogs (Genus <i>Hemiphractus</i>)	21
Treefrogs (Genus <i>Hyla</i>)	22
Broad-headed Treefrogs (Genera <i>Osteocephalus</i> and	39
<i>Phrynohyas</i>)	
Leaf Frogs (Genera <i>Agalychnis</i> and <i>Phyllomedusa</i>)	43
Narrow-headed Treefrogs (Genera <i>Scarthyla</i> and <i>Scinax</i>)	47
Hatchet-faced Treefrogs (Genus <i>Sphaenorhynchus</i>)	50
TERRESTRIAL FROGS (FAMILY LEPTODACTYLIDAE)	52
Eleutherodactylines	53
Leptodactylines	64
NARROW-MOUTHED FROGS (FAMILY MICROHYLIDAE)	73
AQUATIC FROGS (FAMILY PIPIDAE)	77
POND FROGS (FAMILY RANIDAE)	78
SELECTED REFERENCES	79
PLATES 1–12	Following p. 80
MAP OF QUITOS REGION	Inside Back Cover

BIOGRAPHICAL SKETCHES



The authors at Explorama Lodge, Peru, April 1993.
Photograph by Charles Olmstead.

LILY O. RODRÍGUEZ received her doctoral degree in ecology at the University of Paris in 1991. Since 1979, she has conducted field research in Amazonian Peru on the taxonomy, ecology, and life histories of frogs. She is a Research Associate of the Museo de Historia Natural, Universidad Nacional Mayor de San Marcos in Lima, Peru, and a Field Associate of the American Museum of Natural History, New York. Address: Museo de Historia Natural, Apartado 14-0434, Lima 14, Peru.

WILLIAM E. DUELLMAN received his Ph.D. from The University of Michigan in 1956. Since 1959, he has been associated with The University of Kansas, where he is Curator of Herpetology in the Natural History Museum and Professor in the Department of Systematics and Ecology. Most of his more than 270 publications deal with the systematics, life history, and ecology of frogs in tropical America. Address: Natural History Museum, University of Kansas, Lawrence, Kansas 66045-2454, USA.

PREFACE

Within the past two decades devastation of the Amazon rainforest has attracted the attention of not only biologists and conservationists, but also the general public. Biologists have endeavored to inventory the biota, and conservationists have struggled to preserve large tracts of the rainforest. Amateur naturalists and lay persons from all walks of life have ventured to the Amazon Basin to witness the wonders of this, the largest rainforest on earth; as a consequence, many of these persons have become effective advocates for the conservation and study of the rainforest and the fantastic wealth of living organisms found there.

Iquitos, Peru, is one of the most important departure points for biological investigations, conservation efforts, and ecologically sensitive tourism. (Other major points are Puerto Maldonado, Peru, and Manaus and Belém, Brazil.) Through the combined efforts of Explorama Tours of Iquitos and International Expeditions, Inc., in the USA, a series of International Rainforest Workshops was initiated in 1991. These workshops have subsequently involved dozens of volunteer instructors and served as an educational experience for several hundred workshop participants. It was while serving as an instructor in the first of these workshops that the first author observed many photographs of frogs taken in the area previously by James H. Marlett, and the idea for a guide to the frogs was conceived. In subsequent workshops (1992–1994), the two of us combined our efforts to produce this guide.

We are grateful to Richard Ryel and Richard Mills, International Expeditions, Inc., for inviting us to participate in the workshops. Peter Jenson and his staff of Explorama Tours provided us with comfortable accommodations and efficient logistics. Innumerable workshop participants found many frogs and posed countless questions that helped us formulate this book. For providing some of the photographs used herein, we thank Luis A. Coloma (LAC), Michael J. Doolittle (MJD), Walter Hödl (WH), John D. Lynch (JDL), James H. Marlett (JHM), Roy W. McDiarmid (RWM), Charles W. Myers (CWM), Andrew Young (AY), and especially William W. Lamar (WWL). Their respective photographs are identified by the foregoing initials in the captions; photographs by the authors are identified by the initials LOR and WED. Figures 1–3 were drawn by Amy Lathrop, who deserves accolades for the clarity of her illustrations. We are especially grateful to Joel Souders of the IMG Corporation of Lawrence, Kansas, for his efforts and cooperation in providing images scanned from 35-mm transparencies in an electronic format; these were composed into the color plates using PageMaker™ on a Macintosh computer. We are especially indebted to Linda Trueb, who thoroughly edited the text and skillfully manipulated the text and illustrations

electronically, thereby achieving the high quality of this publication. The entire text was read by William W. Lamar and Erik R. Wild; we thank them for their helpful comments. Richard Mills and B. Anthony Luscombe also offer constructive comments on the text. Publication was achieved by the collaborative efforts of B. Anthony Luscombe, President, Asociación de Ecología y Conservación (ECCO); Dick Mills and Richard Ryel, Amazon Center for Environmental Education and Research (ACEER); and Philip S. Humphrey, Director, Natural History Museum, The University of Kansas.

Lastly, we are indebted to the frogs themselves. Their beauty and fascinating behavior have captivated our attention for many years. Although they do not receive the same general recognition as birds, cats, and monkeys, they do play an important role in the rainforest ecosystem, for which they deserve far more credit than they usually are accorded.

*Lily O. Rodríguez
William E. Duellman
Explorama, Loreto, Peru
March 1994*

INTRODUCTION

About 4,000 species of frogs are recognized worldwide; nearly 1,600 of these live in South America, where the greatest number of species occur in the Amazon rainforest and in the humid montane forests on the slopes of the Andes. More than 80 species have been found at single sites in the upper Amazon Basin in Ecuador and Peru; nowhere else in the world is the frog fauna more diverse. For comparison, this number is about equal to all of the species known in the United States and Canada and more than three times the number of species known from all of Europe. The Iquitos region has a tremendous diversity of frogs, and recent investigations have discovered five species not previously known from that region, as well as some species that are new to science.

Herein we present accounts of 112 species of frogs known from the Iquitos region; 111 of these are illustrated in color. This guide is designed for use by amateur naturalists and professional herpetologists—anyone interested in identifying adult frogs or larvae from the region and learning something about their natural history.

BIOLOGY OF FROGS

Frogs and toads are one (Anura) of the three orders of living amphibians; the others are Caudata and Gymnophiona. The Caudata includes the salamanders, which are most diverse in the Northern Hemisphere. Only two genera of salamanders enter South America, and one species occurs in the Iquitos region. The Gymnophiona are elongate, limbless, wormlike amphibians. These poorly known animals usually live underground (some are aquatic) in tropical regions; several species are known from the Iquitos region. Frogs differ from other amphibians by being specialized for jumping. These specializations include a shortening of the body, absence of a tail, and presence of long, powerful hind limbs. Like the skin of other amphibians, that of frogs is permeable to water, which in warm, dry air will evaporate from the body and result in desiccation and death. Consequently, frogs most commonly live in places where either the ground and/or air are moist or where they can replenish their water supply by entering water. Replenishment is accomplished by soaking up moisture from the substrate or air, not by drinking.

Unlike most terrestrial animals such as salamanders, snakes, and mammals, frogs do not leave scent trails to mark territories and identify potential mates. Instead, frogs, like birds, advertise their presence by sound. With few exceptions, only male frogs vocalize; sounds are produced when air is forced from the lungs over the vocal cords into the mouth and into an expandable vocal sac that acts as a resonating chamber. In a given region, each species of frog has a distinctive call that is recognized by other members of the

species (and probably by some predators). Some frogs produce different kinds of notes; the most common is the *courtship* call to attract females, whereas *territorial* calls are recognized by other males and *encounter* calls are produced during close-range interactions between males.

Most North Americans and Europeans received a stereotyped concept of amphibian reproduction in high school or college biology courses, in which the life history of "the frog" was presented as a simple, annual, three-step process—(1) clumps of eggs are laid in ponds and fertilized by the male while he grasps the female; (2) eggs hatch into aquatic larvae (tadpoles or pollywogs) that feed on algae, grow legs, and metamorphose into froglets; and (3) young frogs move onto land, where they feed on insects and grow into adult frogs that return to the pond the following spring to repeat the reproductive process. Although most frogs in North America and Europe do follow this pattern, there are many other diverse and fascinating modes of anuran reproduction and development, especially in the tropics. In the Iquitos region, many frogs breed throughout the year, and one female may deposit many clutches of eggs annually; other species have explosive breeding periods following heavy rains. Many treefrogs mate in the trees and deposit their eggs on vegetation over ponds; the hatchling tadpoles drop into the water. Another group (Leptodactylines) deposit their eggs in foamlike nests on the surface of ponds or on land adjacent to ponds; the eggs develop in the nest, which reduces chances of desiccation and predation. Eleutherodactylines and dendrobatids deposit eggs on land; in the former, the large eggs undergo direct development into froglets without having an aquatic tadpole stage, whereas in dendrobatids hatchling tadpoles wriggle onto the back of an attending adult who carries the tadpoles to water. There are other kinds of parental care that can be observed in frogs in the Iquitos region. For example, female egg-brooding treefrogs carry their eggs on their back where they develop directly into froglets. In females of the aquatic frogs of the genus *Pipa*, eggs are imbedded in the skin on the back where they undergo direct development into froglets. In some dendrobatids and treefrogs, tadpoles develop in water in arboreal bromeliads, and the females periodically return to the bromeliads to deposit unfertilized eggs for the tadpoles to eat.

Despite our steadily increasing knowledge about the numbers and kinds of frogs and their behavior and life histories, little information exists about many of the species in the Iquitos region. Exciting new information can be gained by any observant person who happens to be in the right place at the right time when frogs are doing something never observed and recorded before.

HOW TO USE THIS GUIDE

This guide is designed to help you identify frogs. Related frogs are grouped under the headings given in the table of contents; following the account of

each group, the species are arranged alphabetically by genus and species. (One genus can contain many species.) Because characteristics given in the account of the group apply to all species included in that group, these characters are not repeated in the accounts of subgroups (if any) or those of individual species. In the species accounts, the paragraph on identification gives the size, which is the total length measured from the tip of the snout to the posterior end of the body. This measurement can be made by laying the frog on its belly along the millimeter rule on the edge of the back cover. In most accounts, a range of sizes is given for males and females; however, because only one or a few specimens might have been available of some species, only one measurement may be given. Thus, it is likely that you may find individuals either smaller or larger than the size indicated. If you find smaller individuals, it is likely that they are juveniles; however, discovery of significantly larger individuals is noteworthy and should be brought to the attention of the authors. Statements about the structural characteristics of the frog and its coloration follow the measurements.

In paragraphs dealing with similar species, comparisons are provided to help you distinguish the species. If you have difficulties identifying a frog, you should consult and compare the descriptions and photographs of the other, similar species. The final paragraph in each account describes various aspects of natural history—habitat, call, reproductive site, eggs, tadpoles, and behavior. Some of the structural features of adults and many features of tadpoles, especially those of the oral disc, can be determined accurately only by use of a 10× hand lens.

For each species illustrated by a color photograph, a reference is made to the color plate in the account of the species. The legends facing each plate refer to the page number of the account and give specific characters to look for on each species.

To identify most species, you will have to handle the frog and carefully examine certain structures (e.g., the amount of webbing between the fingers) or parts of the frog not visible when it is at rest (e.g., color pattern on the hidden surfaces of the hind limbs). Handle frogs (especially small ones) with wet hands, because they dry out rapidly. Remember that *all* frogs have poison glands in the skin. In most species, the toxins are weak and usually not secreted; however, the copious white secretions from some species (especially toads of the genus *Bufo*, the large species of *Leptodactylus*, and treefrogs of the genera *Osteocephalus* and *Phrynohyas*) can irritate your skin and mucous membranes and cause you to sneeze or cry. So-called poison frogs in the family Dendrobatidae do have toxic skin secretions; however, the Amazonian species can be handled safely. Do remember to wash your hands thoroughly after handling any frog or toad.

With an unknown frog in hand, first consult the accounts of the families

and then the color plates illustrating species in that family; next check the accounts of the species to make sure that your frog has the characters of the species that you think it is. If it does not, refer to the section on similar species and check the appropriate accounts. If you cannot identify the frog satisfactorily, repeat the procedure; you may not have associated the frog with the proper family. It is conceivable and an exciting possibility that you might find frogs not identified in this guide. They might be an undescribed species or variants of known species that can be identified by one of the authors (see page iv), if you can provide information on size, coloration, and habitat and a good color photograph of the frog.

NAMES

Unlike most animals in North America and Europe, most frogs in South America lack so-called common names. A notable exception is the large *Leptodactylus pentadactylus*, which locally is called “hualo.” In Amazonian Peru, the few large aquatic frogs are generally simply referred to as “rana” (Spanish for frog), whereas all others are called “sapo” (Spanish for toad). This creates confusion because, in the strict sense, toads are members of the genus *Bufo*, one of hundreds of genera of frogs. Thus, all toads are frogs, but not all frogs are toads, in the same way that all parrots are birds, but not all birds are parrots. In the absence of local common names for the many species of frogs, we refer to them by their scientific names.

Animals are named following the system established by the Swedish biologist, Carolus Linnaeus, in the 1750s; the system results in a nested hierarchy of classification. Thus, related species are grouped into genera, which in turn are grouped into families, orders, and classes. In this system, each organism has a unique name consisting of two parts (genus and species), and the resulting classification places the organism in an hierarchical arrangement of relationships. For example, the common large toad of the Iquitos region would be classified in the following way:

CLASS: Amphibia

ORDER: Anura

FAMILY: Bufonidae

GENUS: *Bufo*

SPECIES: *marinus*

Persons should not be intimidated by scientific names, which are Latin or Latinized Greek. Most people are familiar with many generic names; for example nearly everyone knows common garden plants such as *Chrysanthemum* and *Begonia*; these are generic names. The generic names of frogs usually refer to characteristics of the animals. For example, *Leptodactylus* is derived from the Greek words *leptos*, meaning slender, and *daktylos*, mean-

ing finger or toe, a good descriptive name for these frogs having long, slender toes. The specific name usually describes or modifies the generic name. Thus, the specific name *mystaceus* is derived from the Greek *mystax*, meaning upper lip; *Leptodactylus mystaceus* has a distinctive white upper lip. Sometimes specific names are based on the place where the animal was found; for example, *Hyla sarayacuensis* was first found at Sarayacu, Ecuador. Other species are named for the person who discovered them or contributed in some way to the field of study; for example *Eleutherodactylus malkini* was named for Borys Malkin, who assembled large collections of frogs from the Amazon Basin including the first specimens of this species. The name of the person who proposed the specific name follows the scientific name; if the name was proposed originally in a genus other than the present combination, the name of the author is in parentheses.

TERMINOLOGY

In order to describe and compare frogs, it is necessary to use some terms for structures and conditions that may not be familiar to everyone. The following definitions are provided to ameliorate this problem; structures are illustrated and labeled in Figures 1–3.

Amplexus Clasping position during reproduction when the male is on the female's back; with the exception of *Pipa*, all male frogs in the Iquitos region have axillary amplexus (arms in armpits of female); *Pipa* clasps around the waist.

Anterior Toward the head.

Aquatic Being in water.

Arboreal Being in trees.

Axilla The armpit.

Axillary membrane Skin extending from the side of the body to the posterior edge of the upper arm in some treefrogs (Fig. 1).

Calcar A fleshy protuberance, usually triangular, on the heel (Fig. 1).

Canthus The ridge between the nostril and eye (Fig. 1). A canthal stripe is a longitudinal mark on the canthus.

Carnivore Animal that feeds on flesh other than insects.

Chromatophore A pigment cell; those that contain only black pigment are melanophores.

Cloaca The common duct for the excretory and reproductive systems opening at the posterior end of the body (Fig. 2).

Cranial crest Bony elevation on the skull (Fig. 1); may be greatly elevated and keratinous (horny) in toads of the genus *Bufo*.

Dermal flap A protrusion of skin; pairs of flaps are in the cloacal region

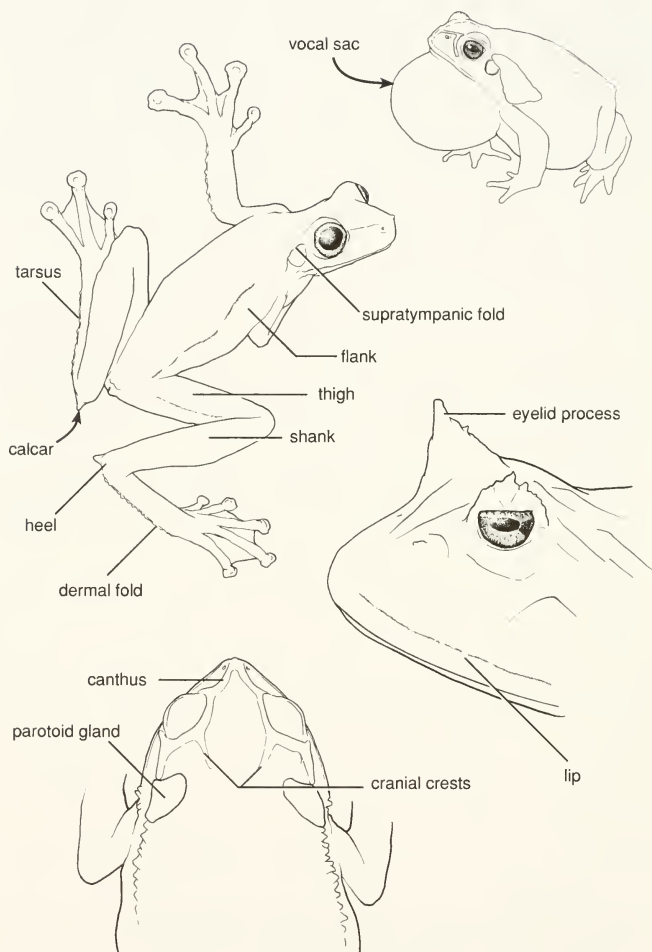


Fig. 1. Gross structural features of frogs.

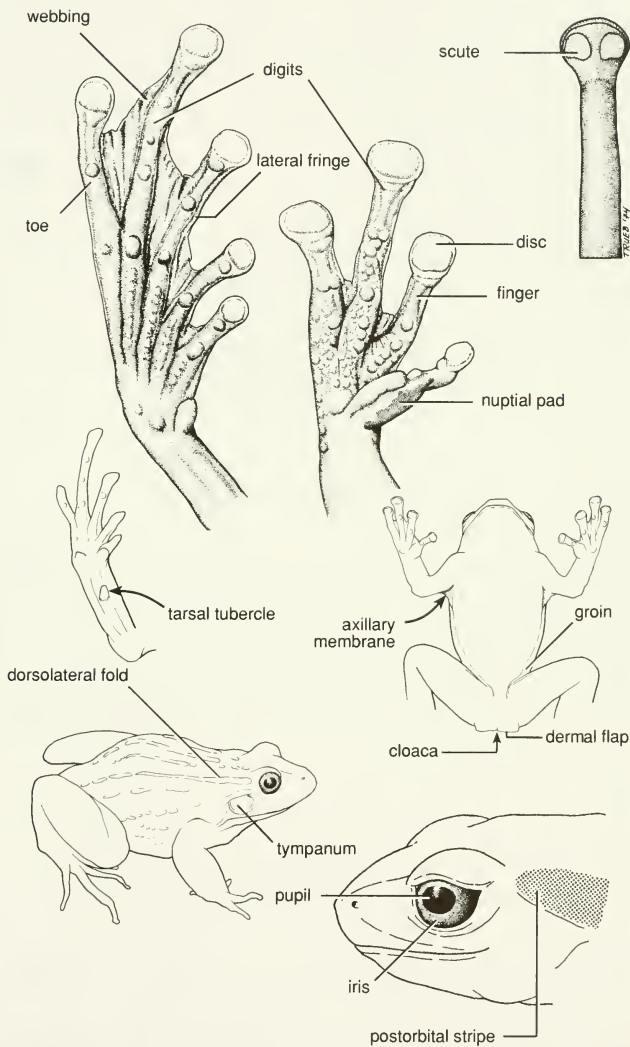


Fig. 2. Details of the hands, feet, and head of frogs.

in some treefrogs of the genus *Sphaenorhynchus* (Fig. 2), and a broad flap is on the upper lip in the aquatic frog *Pipa pipa*.

Dermal fold An elongate ridge of skin along the outer edge of the arm or foot of some treefrogs and leaf frogs (Fig. 1).

Digit Any of the fingers and toes of frogs (Fig. 2)

Disc The delineated terminus of the digit (Fig. 2); discs are usually round and set off ventrally from the axis of the digit in treefrogs; they are truncate and bear scutes dorsally in dendrobatids, rounded or truncate in most eleutherodactylines, small and rounded in leptodactylines, and knoblike in some toads and leptodactylids.

Distal Away from the axis of the body or limb.

Diurnal Active by day.

Dorsolateral fold A ridge of skin on the upper sides of the body (Fig. 2).

Dorsum The back (dorsal surfaces) of the frog.

Eyelid process A fleshy protuberance, usually triangular, on the upper eyelid of some frogs (Fig. 1).

Filament A slender tip of the tail in some tadpoles (Fig. 2).

Finger Any of the four digits on the hand (Fig. 2).

Flank The side of the body (Fig. 1).

Granular Condition of the skin that appears to consist of closely adjacent small bumps.

Groin The posterior part of the flank adjacent to the juncture of the hind limb (Fig. 2)

Heel The terminus of the second segment in the hind limb (Fig. 1).

Hidden surfaces of limbs Those surfaces of the limbs that are not visible when the frog is in a resting (sitting) position with the limbs folded against the body.

Iris The pigmented portion of the eye around the pupil (Fig. 2).

Insectivore An animal that feeds on insects.

Interorbital The area on the top of the head between the eyes.

Jaw sheath The horny coverings of the jaws in tadpoles (Fig. 3).

Labial bar Markings, usually vertical, on the upper lip of frogs.

Labial teeth The horny denticles on the lips of tadpoles (Fig. 3).

Lateral Referring to the side.

Lateral fringe A fold or keel of skin along the lateral edges of digits (Fig. 2).

Lip In frogs, the upper margin of the jaw below the nostrils and eyes (Fig. 1); in tadpoles, the fleshy processes peripheral to the mouth and making up the oral disc (Fig. 3).

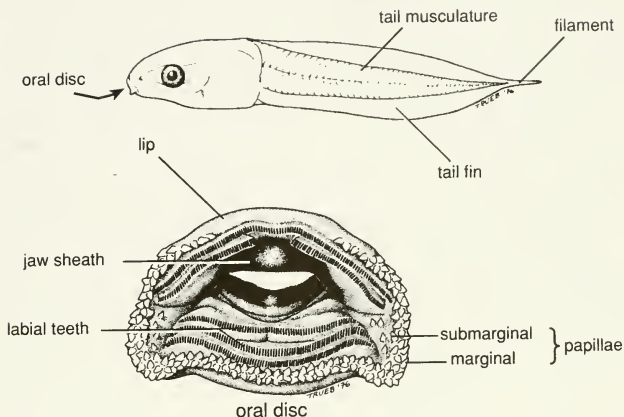


Fig. 3. Structural features of tadpoles.

LTRF Labial tooth row formula in tadpoles given as the number of rows on the upper (anterior) lip/number of rows on the lower (ventral) lip. Some rows are interrupted medially; this is indicated by that row number in parentheses. Thus LTRF 2(2)/3 indicates two rows on the upper lip and three on the lower; the second (innermost) upper row is interrupted medially (Fig. 3).

Marginal papillae The outermost row(s) of papillae around the oral disc of tadpoles (Fig. 3).

Median Toward the middle.

Nape The neck region on the back of a frog.

Neural spine The dorsal process on a vertebra; in some frogs (e.g., *Bufo typhonius* and *Hemiphractus proboscideus*), they protrude through the dorsal musculature and are visible as a row of bumps down the middle of the back.

Nocturnal Active at night.

Nuptial pad A thickened excrescence, usually darkly pigmented, on the base of the first finger (thumb) of some male frogs when they are in breeding condition (Fig. 2).

Occipital region The posterior part of the head.

Oral disc The structure surrounding the mouth of tadpoles (Fig. 3).

Papillae Small, fleshy protrusions, such as those found around the margin of the oral disc in most tadpoles (Fig. 3).

Parotoid gland A gland containing a concentration of poison glands; these glands are greatly thickened areas on the backs and sides of the head in most toads (Fig. 1) but more diffuse and extending onto the body in most leaf frogs (*Phyllomedusa*).

Posterior Toward the rear end.

Postorbital Behind the eye, such as a stripe (Fig. 2).

Primary forest Pristine rainforest that represents the climax successional stage and has not been logged.

Proximal Close to the axis of the body or limb.

Pupil The opening of the eye that appears black (Fig. 2); when the pupil is constricted in bright light it is horizontally elliptical in most frogs, but in leaf frogs (*Phyllomedusa*) and *Hydrolaetare* it is vertically elliptical.

Pustule An elevated portion of skin.

Roughened A nearly smooth textured surface to the skin.

Rump The posterior end of the body above the cloacal opening.

Sacrum The point of attachment of the pelvic girdle to the vertebral column, usually evident as a hump on the back about two thirds of the length of the body in frogs.

Scapular region The "shoulder" region in frogs immediately behind the head on the back.

Scute A scalelike elevation; a pair of these scutes are present on the dorsal surface of the disc at the end of fingers in dendrobatid frogs (Fig. 2).

Secondary forest Forest that has been logged or otherwise disturbed, usually consisting of mostly smaller trees than primary rainforest.

Semiaquatic Spending part of the time in water.

Serrate Having a rough edge, like saw teeth.

Shank The second segment in the hind limb (calf) (Fig. 1).

Snout The head anterior to the level of the eyes; descriptors such as pointed or rounded refer to the shape in dorsal view.

Spicule A small, conical spine in the skin.

Spine A pointed protrusion on the inner side of the thumb in some male frogs in breeding condition; in most leptodactylines, some of which also have spines on the chest, the spines are horny and black.

Spinous In reference to skin texture having many small spines or spicules.

Subgular Below the throat in reference to the position of the vocal sac.

Submarginal papillae Papillae medial to the marginal papillae on the oral disc of tadpoles (Fig. 3).

Supratympanic fold A thickened fold of skin above the tympanum on the side of the head (Fig. 1).

Tail fin The thin fins on the tail of tadpoles (Fig. 3).

Tail musculature The muscular part of the tail in tadpoles (Fig. 3).

Tarsal tubercle A tubercle about midlength on the ventral edge of the tarsus in the hind foot (Fig. 2).

Tarsus The elongate part of the foot between the heel and toes (Fig. 1).

Temporary pond A pond that is present only during the rainy season.

Terra firme forest Forest that is not inundated during the rainy season.

Terrestrial Being on land.

Thigh The first (proximal) segment of the hind limb (Fig. 1).

Thumb The first (innermost) digit on the hand.

Toe Any of the five digits on the foot (Fig. 2).

Truncate Squared off; used in reference to shape of the snout or digital discs.

Tubercle An elevation of the skin, which may be low and flat, rounded, or conical.

Tympanum The ear drum on the side of the head, usually delineated by an elevated ring (Fig. 2).

Venated A skin texture in which there is a network of depressions.

Venter The underside of the body.

Vocal sac The pouch of skin that serves as a resonating chamber when filled with air (Fig. 1).

Webbing The skin between the fingers and toes (Fig. 2). The extent of webbing is expressed as a fraction of the length of the digits that are connected by web.

GUIDE TO THE FROGS

TOADS (FAMILY BUFONIDAE)

True toads, genus *Bufo*, have large parotoid glands on the side of the head; most species have tuberculate skin on the dorsum and conspicuous bony crests on the head. Toads are terrestrial and insectivorous; ants make up a majority of the diet in some species. Adults congregate at ponds or slow-moving streams for breeding. Small, pigmented eggs are laid as pairs of strings in water. The tadpoles are small and black. The oral disc is directed anteroventrally and has one row of marginal papillae laterally but no

papillae dorsally and ventrally; the LTRF is $2(1)/3$. Other genera of bufonids in the Iquitos region lack parotoid glands and bony crests on the head.

Atelopus spumarius Cope (Plate 1F)

Identification: Males 26–29 mm, females 31–39 mm. The body is depressed; the head is narrow, and the snout is pointed. The tympanum is absent; the skin on the dorsum is finely spiculate, nearly smooth, like that on the venter. The digits are short with rounded tips. The thumb is extremely short, and the first two toes also are short and included in a padlike web. Usually the dorsum has irregular, longitudinal black marks separated by pale green areas in which small black spots are present; some individuals have dark brown markings separated by tan. The venter is pale yellow with black markings. The palms, soles, and proximal ventral surfaces of the thighs are bright orange. The iris is pale greenish gold.

Similar species: The only other frog in the region with orange palms and soles is the smaller *Dendrophryniscus minutus*, which is uniform brown above and has strongly spiculate skin on the dorsum.

Natural history: This frog is active by day on the ground in primary forest. When disturbed by a potential predator, the frog often arches its back while rocking on its belly with the bright orange palms and soles turned upward. The tadpoles attain lengths of about 15 mm, of which the tail is about one half of the total length. The large mouth is ventral in the anterior part of a large suctorial disc, by means of which the tadpole adheres to objects in swiftly flowing streams. The lower lip is bare; elsewhere, there is a single row of small, blunt marginal papillae. The jaw sheaths are slender, and the LTRF is $3/3$.

Bufo ceratophrys Boulenger (Plate 1C)

Identification: Male 65 mm, female 82 mm. The skin on the dorsum is weakly spinous, and the venter is granular. A prominent, triangular dermal projection is present on the outer edge of the eyelid. The cranial crests are low, except for an elevated knob posteromedial to the eye. The parotoid glands are elongately elliptical and project dorsolaterally from the body; a row of conical tubercles extends from the end of the gland to the groin. The first finger is much longer than the second, and the toes are about one-fourth webbed. The dorsum is pale brown with irregular dark brown markings on the back and transverse bars on the limbs; the venter is creamy tan mottled with brown.

Similar species: The presence of a large eyelid projection readily distinguishes this species from all other toads in the region. The only other frog with a large eyelid projection is *Ceratophrys cornuta*, which has a smooth dorsum and lacks cranial crests and parotoid glands.

Natural history: Little is known about this toad, which is active on the ground in primary forest by day and feeds on termites.

***Bufo dapsilis* Myers and Carvalho (Plate 1A)**

Identification: Male 65 mm, female 77 mm. The skin on the dorsum is smooth; the skin on the venter is granular. In dorsal view, the snout is pointed with a fleshy, upturned process. The cranial crests around the eyes and extending to the parotoid gland are moderately elevated; other cranial crests are absent or diffuse. The parotoid glands are slender and about three times as long as the upper eyelid. A row of large, cream tubercles extends from the posterior tip of the parotoid gland to the groin. The first and second fingers are about equal in length, and the toes are about one-half webbed. The dorsum is tan with a few irregular black spots; the flanks are orange-tan. The venter is creamy tan heavily suffused with grayish brown, and the iris is pale gold with black flecks.

Similar species: The only other toad in the region having smooth skin on the dorsum is *Bufo glaberrimus*, which lacks a fleshy process on the snout, as does *Bufo typhonius*. The species of *Hemiphractus* have an elongate process on the snout, but they lack parotoid glands and have triangular heads. *Scinax garbei* has a small, pointed proboscis but has red and black bars on the thighs and expanded discs on the digits.

Natural history: The few specimens known of this toad have been found amidst leaf litter on the ground in primary forest. The eggs and tadpoles are unknown.

***Bufo glaberrimus* Günther (Plate 1B)**

Identification: Males and females to 80 mm. The skin on the dorsum is smooth with scattered low pustules; the skin is smooth on the throat and chest and weakly granular on the belly. Cranial crests are absent; the parotoid glands are ovoid and about twice the length of the eyelid. The first finger is longer than the second, and the toes are about one-half webbed. The dorsum is orange-tan to olive-tan; the sides of the head and flanks are dark brown, and the venter is grayish brown with cream spots. The iris is pale gold with black reticulations.

Similar species: This toad differs from all other *Bufo* in the region by lacking cranial crests and tubercles on the dorsum. These characters and the presence of a pale dorsum and dark flanks and venter immediately distinguish this species from all other toads and toadlike anurans in the region. *Bufo dapsilis* also lacks tubercles on the dorsum, but it has cranial crests and a fleshy proboscis on the snout.

Natural history: Little is known about this inhabitant of primary and sec-

ondary forest; adults have been found on the forest floor at night, and adults and juveniles, beneath logs by day.

***Bufo marinus* (Linnaeus) (Plate 1E)**

Identification: Males 102–130 mm, females 110–150 mm. The skin on the dorsum is tuberculate with horny tips on the largest tubercles, and the throat and belly are coarsely granular. The cranial crests are moderately low and horny in large adults; the parotoid gland is huge, more than twice the length of the eyelid, triangular, and extending ventrally nearly to the jaw. The first finger is longer than the second, and the toes are about two-thirds webbed. The dorsum is grayish tan to reddish brown, with or without darker spots, and the venter is creamy white with grayish brown spots. The iris is pale green suffused with black.

Similar species: Adults of this species can be distinguished from other toads in the region solely by their enormous size, and the triangular parotoid glands and tuberculate dorsum distinguish subadults from other toads. The combination of cranial crests, tubercles on the dorsum, and extensive webbing between the toes distinguish juveniles from *Dendrophryniscus minutus* and small individuals of *Ischnocnema quixensis* and *Eleutherodactylus sulcatus*.

Natural history: This large toad is seldom observed in the forest; instead, it is a common inhabitant of clearings and villages. Males call from the edges of temporary ponds; the call is low, rattling trill. Strings of 4,000–13,000 eggs are deposited in shallow water. Tadpoles are entirely black and attain lengths of 28 mm, of which 60% is tail.

***Bufo typhonius* (Linnaeus) (Plate 1D)**

At least three morphologically distinct species of toads in the Iquitos region are grouped under this name, but these have not yet been recognized formally.

Identification: Males 40–67 mm, females 46–76 mm. The skin on the dorsum is roughened with or without scattered tubercles or the neural spines of the vertebrae protruding through the skin on the back. The venter is granular; a diagonal row of conical tubercles extends from the back of the head to the groin. The snout is pointed, and a tympanum may be present or absent. The cranial crests are elevated, and in some females they are greatly expanded dorsolaterally. The parotoid glands are narrowly elliptical or triangular and confluent with the cranial crests. The first and second fingers are equal in length, and the digits terminate in small, round pads. The dorsum varies from uniform reddish brown to tan with or without large or small dark brown spots or blotches. At least one variety tends to have a bold cream middorsal stripe. The venter is grayish tan to cream with or without cream

spots or gray mottling. The iris is bronze with a greenish gold ring around the pupil.

Similar species: The combination of pointed snout, elevated cranial crests, and lateral row of conical tubercles readily distinguishes these species from all others in the region.

Natural history: All of these toads are diurnal on the forest floor, where their coloration and irregular periphery of spines result in their mimicking dead leaves. All feed primarily on ants. At night they frequently climb onto low leaves to sleep. At least one of the species breeds in slow-moving streams, where they deposit strings of small, pigmented eggs.

Dendrophryniscus minutus (Melin) (Plate 1G)

Identification: Males 15–18 mm, females 17–24 mm. The body is depressed; the snout is pointed, and the tympanum is distinct. All dorsal surfaces are covered with small, pointed tubercles. The dorsum is pale brown, and the flanks are reddish tan, both usually with minute pale blue flecks; a cream labial stripe is present, and the venter is bright orange with black flecks. The palms and soles are orange-red, and the iris is gold medially and brown peripherally.

Similar species: The absence of parotoid glands and cranial crests distinguishes *Dendrophryniscus* from *Bufo*. The orange venter distinguishes *Dendrophryniscus* from other toadlike species in the region—*Physalaemus petersi* with a black and white venter and *Ischnocnema quixensis* with a cream venter with brown spots. *Atelopus spumarius* also has orange palms and soles, but it is larger and has a black and green dorsum and yellow and black venter.

Natural history: A diurnal inhabitant of primary forest, this small toadlike species usually is associated with damp leaf litter, where it feeds primarily on ants. The call consists of two or three quickly repeated, short, high-pitched notes. Strings of 70–250 small, pigmented eggs are deposited in shallow ponds. Tadpoles attain a length of 15.4 mm, two thirds of which is tail. The body is ovoid with a rounded snout and moderately large eyes directed dorsolaterally. The dorsal tail fin is higher than the ventral fin, and the tail terminates in a rounded tip. The LTRF is 2/3. The body and tail musculature are brown; small black flecks are present on the tail.

POISON FROGS (FAMILY DENDROBATIDAE)

Members of this exclusively neotropical family are easily recognized externally by having expanded discs bearing a pair of scutelike structures on the dorsal surface of each digit and a distinctive dorsal silhouette with the

head as wide as the body, rather small eyes and a truncate snout. Dendrobatids are small diurnal frogs; most species are terrestrial. Many species are famous for their bright warning (aposematic) coloration: these species possess strong alkaloids in the skin. However, none of the species in the Iquitos region is highly toxic. All dendrobatids feed primarily on ants and exhibit diverse kinds of courtship behavior and parental care. Small clutches of eggs are deposited out of water where they are attended by one of the parents; upon hatching the tadpoles wriggle onto the back of the attending parent who carries them to water—small streams in some species, or bromeliads or other constrained bodies of water in other species—where the tadpoles develop and undergo metamorphosis.

Colostethus marchesianus (Melin) (Plate 2A)

Identification: Males about 14–18 mm, females 16–18 mm. The skin is finely granular on the dorsum and smooth on the venter. The dorsum is tan to reddish brown with small black spots; conspicuous brown dorsolateral stripes are bordered below by a white stripe. The flanks are mottled tan and cream. The belly is immaculate creamy white and the throat is light yellow, darkest in males. Fingers and toes lack webbing. The iris is gold with black flecks.

Similar species: This is the only dendrobatid in the region lacking bright dorsal coloration or spotted venter. It might be confused with *Scarthyla ostinodactyla*, a small hyliid, which has broad dark brown and white dorsolateral stripes but is slender, with extensively webbed feet, a more pointed snout, a greenish coloration, and green bones.

Natural history: Diurnal and terrestrial, these forest-dwelling frogs are most common in areas of humid soils and leaf litter. Males are territorial and call from slightly elevated sites on the ground—sticks, palm fronds, small logs, and leaves. The call consists of two chirplike notes produced at a rate of about 72 per min. Unpigmented eggs, about 2 mm in diameter, are deposited on the ground or amid leaf litter. Clutches of 4–27 eggs are laid continuously during the rainy season (December–June). Tadpoles are carried by the male to small forest ponds, swamps, shallow slow-moving streams, or water in the axils of fallen palm fronds. Tadpoles can attain a total length of about 20 mm. The body is ovoid with a blunt snout; the eyes are widely separated and directed dorsolaterally, and the nostrils are midway between the tip of snout and the orbits. The oral disc is anteroventral, with a single row of marginal papillae interrupted on the upper lip. The LTRF is 2(2)/3(1). Recently metamorphosed frogs have lengths of 7–9 mm.

Dendrobates reticulatus Boulenger (Cover)

Identification: Males 13–15 mm, females 14–17 mm). The dorsum is bright

red with black spots posteriorly on the body; the flanks, legs and venter are black with pale blue reticulations. Males lack a vocal sac.

Similar species: *Dendrobates ventrimaculatus* also has a reticulated pattern ventrally and on the legs, but *D. ventrimaculatus* has black dorsum with golden stripes and is slightly larger than *D. reticulatus*. *Epipedobates parvulus* and *E. zaparo* have coarsely granular skin on the dorsum that is dull red and lack a reticulated pattern on the legs and venter.

Natural history: This diurnal frog occurs in primary and secondary forest; it is primarily terrestrial but also climbs tree trunks. Little is known about its habits. The call is a long series of pulsed buzzlike notes. Females have two or three eggs (about 2 mm in diameter); males have been observed carrying one or two tadpoles to bromeliads.

Dendrobates ventrimaculatus (Shreve) (Plate 2C–D)

Identification: Males 15–17 mm; females 16–18 mm. Individuals in this region have a black dorsum usually with a pattern only of three bright golden longitudinal lines; the median line extends only to the middle of the back. Some individuals have pale reticulations laterally. Ventrally, the lines form a short X-shaped mark below the jaw. The limbs, flanks and venter are reticulated with pale blue on black. The skin is smooth.

Similar species: The smaller *Dendrobates reticulatus* also has the reticulated pattern on the limbs and venter but has a red dorsum.

Natural history: This small diurnal frog is most frequently seen on logs or amidst leaf litter in humid forest. Individuals have been observed hopping up trunks of large trees to heights of 30 m. The call is a buzzlike note. Its reproductive biology is unknown, but presumably tadpoles are deposited in arboreal bromeliads, where adults sometimes are observed.

Epipedobates femoralis (Boulenger) (Plate 2I)

Identification: Males 21–24 mm, females 24–29 mm. The granular dorsal skin is brown to dark brown and separated from the black flanks by a thin white dorsolateral stripe extending from the tip of the snout posteriorly above the eye to the groin. A white labial stripe is confluent with a bright yellow stripe on the base of the arm. The first finger is longer than second, and the toes have basal webbing. An elongated bright yellow spot extends from the groin upwards to the rear of the dark thighs. The venter is cream with dark brown spots, and the throat is uniform dark brown. The iris is brown.

Similar species: This species is easily confused with the slightly smaller *E. hahneli*, which is more slender, has a blue venter and a more anterior and round yellow spot in the groin. The leptodactylid frog *Lithodytes lineatus* also resembles *E. femoralis* in dorsal coloration but it is larger and has a

uniformly gray venter and usually large red spots on the thighs.

Natural history: Terrestrial and diurnal, *E. femoralis* possesses a distinctive call of two short, notes (“keeree-keeree, keeree-keeree”) that can be heard throughout the day in primary or secondary forest and in clearings. Males are territorial and call from low perches. Females approach calling males in their territories (8–26 m²) and are led to an oviposition site. Females deposit 8–43 eggs, 2.1 mm in diameter; the eggs hatch in about 2 weeks. Males apparently transport all the resulting tadpoles at one time to small ponds, swamps, streams, or water-filled cavities in logs. The tadpoles have flattened oval bodies, and a long, narrow tail; the eyes are dorsal, directed laterally, and moderate in size; the oral disc is rounded and ventral, bordered by a single row of large papillae, the median part of the upper lip is bare, and the lips are shallowly indented laterally. The LTRF is 2(2)/3(1,2). The fins are shallow, and the dorsal fin does not extend onto the body. The body and throat are pale brown with tan flecks; the belly and tail are translucent with scattered tan flecks on the tail. Maximum size is 22 mm (body 8 mm), but back-riding tadpoles are about 11 mm (body 4 mm).

Epipedobates hahneli (Boulenger) (Plate 2G)

Identification: Males 17–19 mm, females 19–22 mm. The back and limbs are finely granular, brown, with or without black spots. The flanks are black, bordered above by a narrow, white or cream dorsolateral line extending from the tip of the snout to the groin. A white or cream labial stripe does not extend onto the arm. The first and second fingers are about equal in length. The venter is blue with black reticulations. Yellow-orange oval spots are present on the ventral surfaces of the arms, inner surfaces of the shanks, and in the groin. The iris is dark brown.

Similar species: The slightly larger *E. femoralis* is similar to *E. hahneli* in dorsal coloration but differs by having a venter cream with dark brown spots and a large crescent-shaped yellow spot in the groin and on the thigh. *Epipedobates parvulus* and *E. zaparo* also have blue venters, but in those species the dorsum is dull red, and there is no white dorsolateral stripe. The much larger leptodactylid frog *Lithodytes lineatus* has a broad dorsolateral stripe, gray venter, and red spots on the thigh.

Natural history: Diurnal and terrestrial, this species is usually associated with fallen palm fronds, branches, and small gaps in the forest. The territorial call is a long series of short notes “peep-peep-peep-peep-peep”; the courtship call is similar, but consists of only three notes. Females produce 6–33 (mean 22) pigmented eggs, with a maximum diameter of 2.3 mm. While being transported from land to water, tadpoles are arranged symmetrically

on the backs of males. The tadpoles are brown with a depressed body, long tail, and dorsal eyes oriented anterolaterally. The tail fins are shallow, highest at midlength; the dorsal fin does not extend onto the body. The oral disc is wide and anteroventral; the lower lip is conspicuous with one row of marginal papillae; the upper lip lacks papillae. The LTRF is $2(2)/3$.

***Epipedobates parvulus* (Boulenger) (Plate 2G)**

Identification: Males 18–23 mm; females 21–24 mm. This dendrobatid lacks dorsolateral stripes and has granular dorsal skin. The dorsum is dull red with a yellow spot in the axilla and groin. The limbs are brownish gray with pale blue flecks, and the flanks and venter are pale blue with diffuse black reticulation. The sides of the head are black, and there is a pale blue labial stripe.

Similar species: The only other frog in the region that can be confused with this species is *Epipedobates zaparo*, which also has a coarsely granular red dorsum, but it differs by having a bluish white stripe on the flank and lacking a yellow spot in the axilla and in the groin. The smaller *Dendrobates reticulatus* has a bright red dorsum and black and blue reticulations on the legs.

Natural history: This is a diurnal terrestrial frog usually inhabiting upland forests. Males usually call at dawn and dusk from slightly elevated perches covered with plants. The call consists of two soft peeps; the second note is higher pitched than the first. Females contain 4–16 eggs with a maximum diameter of 3 mm. Males carry five or six tadpoles to isolated forest pools or streams. Tadpoles on the back are 12–14 mm long, of which the body is about 4 mm. Free-living tadpoles have a LTRF of $2(1)/2$; the oral disc is bordered laterally and ventrally by one row of papillae; the body is dark brown and the tail tan with brown flecks.

***Epipedobates trivittatus* (Spix) (Plate 2H)**

Identification: Males 37–40 mm, females 42–46 mm. The dorsal skin is granular; the fingers are long, and first finger is longer than second. The dorsum is black with a bright greenish yellow stripe from the tip of the snout to the groin. The pattern of black and greenish yellow is diffuse on the limbs. The venter is black with blue spots, and the iris is dark brown.

Similar species: This is the only frog in the region with a granular black and green dorsum. All other dendrobatids are smaller in size and have different color patterns. Young individuals can be mistaken for *E. hahneli*, but they differ in having first and second fingers about equally long.

Natural history: Diurnal and terrestrial, *E. trivittatus* usually is found throughout the forest and edges of clearings, most commonly near dead palm

fronds, where it feeds primarily on small ants. Males call from the ground or some low perch, mainly early in the morning and late in the afternoon. The call is a series of ticklike notes. A female 43 mm long had 66 eggs with a maximum diameter of 3.2 mm; eggs hatch 14–17 days after fertilization, and the total duration of larval development is 41–54 days. Males carry up to 45 tadpoles about 16 mm long. The body and the tail musculature are dark gray to black; in free-living tadpoles, the tail is 64% of the total length. The tail musculature is robust, and the fins are shallow; the upper fin is present only on the distal two thirds of the tail. The oral disc is indented laterally and bordered laterally and ventrally by one row of papillae; the LTRF is $2(2)/3$.

Epipedobates zaparo (Silverstone) (Plate 2F)

Identification: Males 20–30 mm, females 26–31 mm. The dorsal skin is coarsely granular. The dorsum is dark red, and the flanks are black. A distinct bluish-white labial stripe continues onto the base of the arm, and a bluish white stripe extends from midflank to the groin. The limbs are black with pale blue flecks, and the venter is pale blue with black reticulations.

Similar species: The only other frog in the region that can be confused with this species is *Epipedobates parvulus*, which also has a coarsely granular red dorsum, but it lacks a white stripe on the flank and has a yellow spot in the axilla and in the groin. The smaller *Dendrobates reticulatus* has a smooth red dorsum and blue venter, and it has black and blue reticulations on the limbs. *Epipedobates hahneli* also has a blue venter, but it has finely granular skin dorsally and a narrow pale dorsolateral stripe.

Natural history: The frog is active in humid leaf litter in upland forest by day. Nothing is known about its reproduction.

TREEFROGS (FAMILY HYLIDAE)

Frogs of the family Hylidae make up a major component of the Amazonian frog fauna. With only a few exceptions, members of this group are nocturnal and arboreal, but most species descend to low vegetation or the ground around lakes, ponds, and streams for breeding, at which time choruses may consist of hundreds of individuals of more than a dozen species. All treefrogs have expanded discs at the ends of the fingers and toes; these are offset ventrally from the axis of the digit. Also, most treefrogs have extensive webbing between the toes (and between the fingers in some species); these features, in combination with granular skin on the belly and large, protruding eyes, serve to distinguish treefrogs from other groups of frogs in the region.

EGG-BROODING FROGS (GENUS *HEMIPHRACTUS*)

One group of treefrogs, members of the subfamily Hemiphractinae, have a unique reproductive mode. Large, unpigmented eggs develop openly on the back or in a pouch on the back of the female. In some species the eggs hatch as tadpoles, but in most the eggs hatch as miniatures of the adults. The species in the Iquitos region brood the eggs on the back, and the eggs hatch as froglets.

***Hemiphractus johnsoni* (Noble) (Plate 8D)**

Identification: Males 44–53 mm, females 61–77 mm. This weird-looking frog has a deep, triangular head with a fleshy, depressed, pointed snout (proboscis) and an enlarged tubercle on the eyelid. The body is depressed, and the neural spines of the vertebrae protrude through the skin on the back. The forearms have scattered tubercles, and the heels bear small calcars. The fingers are not webbed, and the toes are webbed basally; all digits bear expanded discs. The dorsum is tan with brown spots or diagonal bars, and dark brown bars are present on the limbs; the venter is grayish white. The pupil is horizontally elliptical, and the iris is pale silvery bronze.

Similar species: *Hemiphractus proboscideus* has a larger, laterally compressed proboscis and further differs by having tubercles in transverse rows on the forearms and prominent calcars on the heels. The larger, more robust *Hemiphractus scutatus* has a small proboscis and lacks calcars. *Bufo dapsilis* has a fleshy, upturned process on the snout, but it lacks tubercles on the eyelids and protruding vertebrae.

Natural history: This frog occurs only in primary forest, where individuals are found sitting on low vegetation at night. No mating call has been associated with this frog. Females carry up to 18 eggs.

***Hemiphractus proboscideus* (Jiménez de la Espada) (Plate 8E)**

Identification: Males 43–50 mm, females 52–67 mm. This bizarre frog has a triangular head with a fleshy, laterally compressed, pointed snout (proboscis) and an enlarged conical tubercle and several smaller tubercles on the eyelid. The body is depressed, and the neural spines of the vertebrae protrude through the skin on the back. The forearms have conical tubercles in transverse rows, and the heels bear prominent calcars. The fingers are not webbed, and the toes are one-third webbed. All digits bear expanded discs; those on Fingers I and II are orange. The dorsum is brown or tan with green, brown, or gray marks on the body and transverse bars on the limbs; the flanks are dirty white, and the venter is brown with orange spots on the belly and pale tan spots on the throat. The tongue is bright yellow. The pupil is horizontally elliptical, and the iris is silver with black reticulations.

Similar species: *Hemiphractus scutatus* is larger with a more robust body; furthermore, *H. scutatus* lacks calcars on the heels and the prominent proboscis of *H. proboscideus*. *Hemiphractus johnsoni* differs by having scattered tubercles on the forearm, a depressed proboscis, and small calcar. *Bufo dapsilis* has a fleshy, upturned process on the snout, but it lacks tubercles on the eyelids and protruding vertebrae.

Natural history: This frog occurs only in primary forest, where most individuals are found sitting on low vegetation at night, especially during the rainy season, when juveniles are also found. No mating call has been associated with this frog. Females carry up to 26 eggs. *Hemiphractus proboscideus* is a carnivore feeding mainly on other frogs, lizards, and large invertebrates. When disturbed, these frogs will open their mouths and display the bright yellow tongue (gaping defense posture) and will bite fingers.

Hemiphractus scutatus (Spix) (Plate 8F)

Identification: Males 50–62 mm, females 68–81 mm. The head is broadly triangular with fleshy horns on the eyelids, a short proboscis and a large tympanum. The limbs bear oblique rows of tubercles on the dorsal surfaces; the heels lack calcars. The digital discs are slender, not evident in dorsal view; the fingers are about one-fourth, and toes one-half webbed. The dorsum changes from brown by day to tan at night; the venter is creamy tan, and the throat is dusty tan with oblique dark brown bars converging towards the midline.

Similar species: The only other “horned” frogs are the robust *Ceratophrys cornuta*, which has a rounded snout and short limbs, the more slender and smaller *Hemiphractus johnsoni* and *proboscideus*, which have fleshy pointed snouts and a triangular head well differentiated from the body, and the minute *Pseudopaludicola ceratophyes*, which is pale tan and has a prominent tubercle on the tarsus.

Natural history: This terrestrial, nocturnal frog is found only in undisturbed forests, where it feeds on frogs and large arthropods. Like *Hemiphractus proboscideus*, it displays the gaping posture, showing an orange tongue. Males call from beneath logs on the ground. The call is a loud “cro-wahh.” After mating, the female remains at the male’s calling site; she carries about 17 eggs on her back for approximately 10 weeks.

TREEFROGS (GENUS *Hyla*)

Most Amazonian treefrogs belong to this large genus, which includes several species in North America and Eurasia. Members of this genus range in size from about 20 to more than 100 mm. Males have a single, median, subgular vocal sac and usually have pigmented nuptial pads on the inner

edge of the thumb. The skin on the belly is granular, and the pupil is horizontally elliptical. *Hyla* are sit-and-wait predators on a great variety of insects and spiders.

Hyla allenorum Duellman and Trueb (Plate 3A)

Identification: Males 18–20 mm; females 26 mm. This small frog has distinctive ventral coloration—white anteriorly, black with bluish flecks posteriorly, and black thighs. The flanks are white; the dorsum brown with small yellow flecks. The iris is brown. The snout is short, and the head is as wide as the body; the dorsum is smooth, and an axillary membrane is absent. The hands one-third webbed, and feet, almost fully webbed. Males have large median vocal sacs but lack nuptial pads on thumbs.

Similar species: *Hyla parviceps* has black on the belly but it has an orange spot on the ventral surface of each shank..

Natural history: Breeding occurs in vegetation-choked ponds. The call is a short series of cricketlike chirps; pigmented eggs are laid in water. Tadpoles attain lengths of 16.1 mm, of which the tail is 60% of the length. The body is bluntly ovoid from above and broader than deep. The eyes are lateral, large, and reddish brown. The dorsal fin as high as the tail musculature, and the ventral fin is shallower; the tail terminates in a small flagellum. The oral disc is small, anteroventral, and lacks marginal papillae, labial teeth, and lateral folds. The jaw sheaths are broad, V-shaped, and serrated. The body is dark brown with creamy gold dorsolateral stripes from the snout to the sides of tail; the fins are clear with brown blotches present only posteriorly.

Hyla bifurca Andersson (Plate 4C)

Identification: Males 23–28 mm, females 29–35 mm. This small treefrog has a brown dorsum with cream markings—snout, narrow dorsolateral stripes, and spots on the rump and heels. The hidden surfaces of the limbs and the webbing on the feet are orange brown. The vocal sac is yellow, and the iris is grayish bronze. The skin on the dorsum is smooth; the snout is short, an axillary membrane extends nearly to the elbow. The fingers are webbed basally, and the toes are two-thirds webbed.

Similar species: This species is like *H. leucophyllata*, and *H. sarayacuensis* in having a distinctive herbal odor. Two other brown treefrogs in the region have extensive axillary membranes and pale dorsolateral stripes. *Hyla leucophyllata* and *H. sarayacuensis* have orange webs and hidden surfaces of the limbs; the dorsolateral stripes are broad (also with irregular margins in *H. sarayacuensis*), and pale transverse bands are present on the limbs. *Hyla triangulum* also has axillary membranes, but the hidden surfaces of the limbs and webbing are red. *Hyla minuta* has the spots on the rump and heels but lacks dorsolateral stripes.

Natural history: An inhabitant of open forest and clearings, these frogs breed in shallow ponds, where males call from emergent vegetation in the ponds. The call is a harsh primary note followed by two shorter notes. Clutches of about 200 heavily pigmented eggs about 2 mm in diameter are deposited on the upper surfaces of leaves of emergent plants. Upon hatching, the tadpoles drop into the water and develop in vegetation-choked parts of ponds. Tadpoles attain lengths of 31 mm, of which 70% is tail. In dorsal view the body is violin-shaped; the tail fins are shallower than the musculature, and the tail terminates in a long filament. The oral disc is anterior; the median part of the upper lip is bare, but elsewhere the disc is bordered by large, blunt papillae. The jaw sheaths are robust and serrated; labial teeth are absent. The body is tan above with broad black and cream lateral stripes; the belly is silvery white with three black stripes; the tail is black proximally and cream with black flecks distally.

Hyla boans (Linnaeus) (Plate 5A)

Identification: Males 84–118 mm, females 88–110 mm. This large treefrog with long limbs and small calcars has a broad head and a round snout, large eyes, and a distinct tympanum. The dorsal skin is smooth; the toes and all fingers, except the first one, are fully webbed. The dorsum is tan to brown with darker blotches on the back and transverse bars on limbs; the flanks are grayish tan with diffuse dark brown vertical bars, and the webbing is brown. The iris is bronze and the lower eyelid has silvery gold reticulation. Males have a projecting spine on the thumbs.

Similar species: *Hyla geographica* shares the golden reticulation on the lower eyelid but the vertical narrow dark bars on flanks are more conspicuous, and the webbing on the hand is less extensive than in *H. boans*. The much smaller *Hyla microderma* also has reticulations on the lower eyelid, but it lacks vertical marks on the flanks and webbing on the hands. *Hyla lanciformis* has a pointed snout, lacks markings on the flanks and has distinctive brown and white blotches on the throat. *Hyla calcarata* and *H. fasciata* also have prominent calcars, but they are much smaller and have conspicuous black bars on the flanks and thighs. Treefrogs of the genus *Osteocephalus* also are large and brown, but they differ by having bluntly rounded snouts, tuberculate skin on the dorsum in males, and little webbing on hands, and by lacking calcars and reticulations on the lower eyelids.

Natural history: Unusual among frogs, males of *Hyla boans* are larger than females. Adults inhabit trees in the rainforest, but during the dry season they are active at night on sandy or muddy edges of slow-moving streams. Males construct shallow basinlike nests in mud or sand near water; the basins are less than a meter in diameter. The depth is below the water level in the adjacent stream or river, so water seeps into the basin. Males call from low perches

near, or the margins of, the basins, and they defend their basins from other males. The call is a series of 3–10 short loud notes produced at a rate of 38 notes per min. Clutches may contain more than 3,000 pigmented eggs about 2 mm in diameter deposited as a surface film in the basin. One basin may contain tadpoles of several sizes, thereby indicating that a male has had more than one successful mating. Tadpoles develop in the shallow pools in the basins; they are able to tolerate temperatures up to 39°C. Sometimes they are washed out of the basins by high water; when this happens the tadpoles remain together close to the shore. Tadpoles can attain a total length of 43 mm, of which 65% is tail. The body is ovoid and transparent olive brown; the tail fins are transparent, but the tail muscle has dark dorsal blotches and is as deep as the dorsal fin, twice the depth of the ventral fin. The eyes are yellow, large, and dorsolateral. The oral disc is ventral and triangular in shape, with a single row of small marginal papillae except medially on the upper lip, and a double row in the lateral folds. The LTRF is 2(2)/3-4(1). Recently metamorphosed young are about 10.5 mm.

***Hyla brevifrons* Duellman and Crump (Plate 3E)**

Identification: Males 17–21 mm, females 20–23 mm. This small frog has a short, truncate snout and an axillary membrane. The skin on the dorsum is smooth; the fingers are one-half and toes, two-thirds webbed. The dorsum is tan with three or four broad, transverse dark marks; a creamy yellow dorso-lateral stripe is narrow in males and broad in females. Two creamy yellow vertical bars are present below the eye; the thighs are dark brown with 1–3 creamy yellow spots on the dorsal surfaces. The venter is white, and the iris is silvery gray with a red ring around the pupil.

Similar species: The only other small frogs that can be confused with *Hyla brevifrons* are *H. allenorum* and *H. parviceps*; the former has a broad white lateral stripe and a black belly with blue flecks, whereas *H. parviceps* has black on the thighs and a bright orange spot on the ventral surfaces of the shank.

Natural history: This nocturnal species usually is observed on leaves of bushes in secondary forest. After heavy rains, the frogs congregate at ponds in, or at the edge of, the forest. Males call from emergent vegetation. The call consists of a series of short insectlike chirps repeated at a rate of about 37 notes per minute. Clutches of 48–114 small (about 1.3 mm), lightly pigmented eggs are deposited on the upper surfaces of leaves of emergent plants. In about six days the eggs hatch, and the tadpoles drop into the water, where they develop amidst detritus on the bottom. The tadpoles attain lengths of 23 mm, of which the tail is about 68%. The body is ovoid and the snout rounded; the eyes are large, widely separated, and directed dorsolaterally. The tail fins are slightly higher than the tail musculature, and the tail terminates in a long

filament. The oral disc is directed anteriorly. The median part of the upper lip is bare; elsewhere the disc has a single row of small fringing papillae. The jaw sheaths are robust and serrate; labial teeth are absent. The body is dark brown with a diffuse tan dorsolateral stripe and cream flecks laterally. The tail is tan with dark brown mottling and a bright red streak on the dorsal fin.

Hyla calcarata Troschel (Plate 4G)

Identification: Males 33–41 mm, females 50–61 mm. The fingers are webbed basally; the toes are one-half (males) to two-thirds (large females) webbed. A prominent triangular calcar is present on the heel. The dorsum is tan to reddish brown (yellowish tan by day) usually with a dark brown middorsal stripe; indistinct darker transverse marks may be evident on the dorsum. The flanks and hidden surfaces of the thighs are white to pale blue with bold black spots or single vertical bars. The venter is white; the webbing on the feet is tan, and a narrow creamy white line is present on the outer edge of the tarsus and above the cloacal opening. The iris is creamy white, and the lower eyelid is unpigmented.

Similar species: *Hyla fasciata* and *H. microderma* are slightly smaller and have narrower, tubercular calcars; the former has irregular black marks on the flanks and thighs and brown flecks on the throat and chest, whereas the latter lacks black marks on the flanks and thighs. Adults of *Hyla boans* and *H. geographica* are larger; both have golden reticulations on the lower eyelid, extensive webbing between the fingers, and different markings on the flanks and thighs.

Natural History: In the rainy season, nocturnal, arboreal adults are most commonly seen perched transversely on stems and small branches above slow moving streams. The call is a low-pitched, rattling note repeated at a rate of about 8 notes per minute. Clutches of 1060–1250 pigmented eggs about 2 mm in diameter are deposited as a surface film on the water; the eggs hatch in 79–86 hours. Tadpoles grow to a length of about 35 mm, of which the tail is about 70% of the length. The body is ovoid, and the tail fins are high (dorsal fin higher than ventral fin). The body is dark brown with faint tan mottling and a tan interorbital bar; the tail is yellowish tan with vertical brown bars. The LTRF is 2(2)/3.

Hyla fasciata Günther (Plate 4H)

Identification: Males 37–39 mm, females 46–51 mm. This slender frog has long limbs, the head wider than the body and the flanks, groin and posterior surfaces of the thighs with many small black blotches or bars on a pale cream background. A small tubercular calcar is present on each heel. The fingers are unwebbed, and the toes are one-half webbed. The eyes are large, with a

horizontally elliptical pupil and creamy silver iris. The dorsum is smooth, tan to yellowish (night) or brown (day) usually with a narrow middorsal dark line and irregular, transverse darker marks; the venter is granular and white to cream.

Similar species: *Hyla geographica* and *H. boans* differ by being larger and having the hands at least one-half webbed and reticulations on the lower eyelids; *H. calcarata* has a more prominent calcar and distinct vertical black bars on the flanks, and *H. microderma* lacks black markings on the flanks and thighs.

Natural history: This nocturnal, arboreal frog usually is found throughout primary and secondary forests and around forest ponds during the rainy season. Males call from low perches, no more than 50 cm above water. The call consists of a soft, diphasic note produced at intervals of about 12 sec. Clutches of up to 1755 pigmented eggs, 1.5 mm in diameter, are laid as a surface film on the water; eggs hatch three days later. Tadpoles attain lengths of 38.1 mm, of which two thirds is tail. The tadpoles are ovoid with the spiracular tube free; the eyes are large, dorsolateral, and narrowly separated. The dorsal fin does not extend onto the body, is equal in height to the tail musculature, and is twice the height of the ventral fin. The oral disc is anteroventral, bordered by a row of small papillae with a narrow gap in the upper lip. In later stages, submarginal papillae appear laterally and on the lower lip, the LTRF is 2(1-2)/3-4(1). The dorsum of the body is greenish-gray with a dark brown streak from the anterior edge of the eye to the oral disc; the venter is whitish tan posteriorly and heavily pigmented anteriorly. The tail is transparent yellow with several interconnected black vertical bands.

Hyla geographica Spix (Plate 5C-D)

Identification: Males 40–62 mm, females 52–83 mm. This large, slender, brown frog has distinctive golden reticulations on the lower eyelid. The dorsum is brown, usually with a darker X-shaped mark in the scapular region; many individuals have irregular black, white or tan spots on the dorsum. The flanks are pale gray with indistinct gray vertical lines or dashes; the venter is white to creamy yellow with small, scattered black spots. The iris is pale brown with a reddish tint. The skin on the dorsum is finely tubercular; the digital discs are large and round, and the legs are long with small calcares on the heels. The fingers are one-half webbed, and the toes about three-fourths webbed. Reproductive males have horny pads on the thumbs.

Similar species: *Hyla boans* is most similar to *H. geographica*; it differs by its larger size and fully webbed hands. *Hyla fasciata* and *H. calcarata* lack reticulations on the lower eyelids and have small black blotches or vertical black bars on white or cream flanks. The much smaller *H. microderma* has reticulations on the lower eyelids and lacks vertical marks on the flanks.

Natural history: This nocturnal treefrog is found along streams, open ponds, lakes, and only rarely inside primary forest. Males call from vegetation above water. The call consists of several chuckles or a long groan. Amplexant pairs lay clutches of over 2400 pigmented eggs, 2 mm in diameter. Tadpoles are black and can attain lengths of 56 mm. The eyes are small, widely separated, and directed dorsolaterally. The tail has a rounded tip, shallow ventral fin shallow, and a dorsal fin as high as the musculature. The oral disc is anteroventral and has lateral folds; except on the median part of the upper lip, the disc is bordered by one row of small papillae. The LTRF is 2-3(1)(3)/3-5(1). Tadpoles form organized schools of 87–2040 individuals and are distasteful to fishes but susceptible to predation by dragonfly larvae. In recently metamorphosed young the flanks and hidden surfaces of the limbs are black.

Hyla granosa Boulenger (Plate 7A)

Identification: Males 37–44 mm, females 41–54 mm. This moderate-size green treefrog has finely granular dorsal skin, sometimes with minute red or gold flecks at night; the snout is bluntly round. The venter is nearly transparent pale green; hidden surfaces are green, usually with a bluish tint. The outer finger is one-third webbed, and the toes about two-thirds webbed. The iris is cream, with a golden ring around the horizontally elliptical pupil and a bright blue border around the rim. Breeding males have a spine on the thumbs.

Similar species: The only other green treefrog with red on the dorsum at night is *Hyla punctata*, which has pale dorsolateral stripes and only basal webbing on the outer finger. Species of *Sphaenorhynchus* have smooth dorsal skin, more webbing on hands and feet, and a pointed snout; none of these frogs have a cream iris.

Natural history: *Hyla granosa* is nocturnal and arboreal; it is rarely observed far from forest ponds. Males typically call from leaves covered by other leaves. The call is 2-4 notes, “boop-boop-boop,” produced at a rate of 14–40 notes per minute. Clutches of about 840 green eggs, 1.6 mm in diameter, are laid in water in forest ponds. Tadpoles are slender with a total length of about 30 mm. The body is wider than deep with a broad snout; the eyes are large, almost dorsal but directed laterally. The tail fins are shallower than the musculature. The oral disc is directed anteroventrally and has lateral folds; the disc is bordered by a single row of papillae, except medially on the upper lip. The LTRF is 2(1,2)/3-4(1). The body is transparent olive brown with scattered chromatophores; the tail is transparent with some white chromatophores.

***Hyla haraldschultzi* Bokermann (Plate 4J)**

Identification: Males 18–22 mm, females 22–25 mm. This small, tan frog is characterized by a finely spiculate skin on the dorsum, especially on the head. The legs are short, and the body is almost as wide as the head. The eyes are not prominent, and the tympanum is small, less than one third of the diameter of the eye. The fingers are webbed only basally, and the toes are one-third to one-half webbed; the digital disks are small. At night, the dorsum is pale cream with small brown longitudinally arranged flecks, which change to brown longitudinal stripes on a tan ground color by day; the flanks and venter are immaculate cream. The iris is yellowish gold with a black median stripe.

Similar species: *Hyla minuta* is slightly larger, and the eyes and digital discs are proportionally larger; furthermore, it has distinctive white marks on the heels and above the cloacal opening. *Hyla riveroi* and *H. leali* differ by having smooth skin and different dorsal patterns. Only juveniles of *Hyla fasciata* share the longitudinal lines on a tan or yellowish dorsum, but it has smooth dorsal skin, long limbs, calcars, and large, bulging eyes.

Natural history: Little is known about the life history of *H. haraldschultzi*. Males and females have been found near open ponds and permanent large streams, where males were calling from grasses. The call consists of about nine harsh-pulses followed by a longer pulse. Tadpoles are unknown.

***Hyla koechlini* Duellman and Trueb (Plate 3G)**

Identification: Males 17–24 mm, females 24–28 mm. The body and legs are slender; the snout is short and truncate. The skin on the dorsum is slightly roughened, and that on the venter is granular; an axillary membrane is absent. The fingers are about one-fourth webbed and the toes about three-fourths webbed. The dorsum is pale yellowish tan at night and cinnamon brown by day, usually with darker, narrow, chevron marks on the body. The side of the head is dark brown with a single pale spot below the eye and a white vertical line on the tip of the snout that is continuous with a line along the canthus and edge of the upper eyelid. The posterior flanks and hidden surfaces of the limbs are dark brown to black. A few individuals have an orange spot on the anterior or posterior surface of the thigh. The iris is tan with a reddish tint medially. Reproductive males have a yellow vocal sac.

Similar species: Of the other small treefrogs in the region having one or two pale spots below the eye, none has uniform black flanks and thighs. Furthermore, *Hyla leali* differs by usually having an X-shaped mark in the scapular region, *H. riveroi* by having narrow brown lines in the scapular region, and *H. parviceps* by having an orange spot on the proximal ventral surface of the shank.

Natural history: At night after rains, adults of this small, arboreal frog descend from trees in flooded forest, where males call from leaves and stems of bushes. The call is a high-pitched note, followed or not by a series of shorter notes. Clutches of 300–350 eggs are deposited as a film on the surface of temporary ponds. The pigmented eggs about 1.1 mm in diameter and lacking distinct capsules hatch in about 48 hours into tadpoles that attain lengths of about 25 mm; the tail accounts for about 60% of the length. The tadpoles have high tail fins that terminate in a long filament. The body is tan with brown flecks and a dark stripe from the snout to the eye, bordered below by a cream stripe. The throat and belly are brown with cream mottling; the tail is brown with three broad, vertical, cream bars. The oral disc is terminal and lacks lateral folds; the upper lip is bare, and the lower lip has a single row of moderately large, fused papillae. The jaw sheaths are robust and serrate; labial teeth are absent.

Hyla lanciformis (Cope) (Plate 5B)

Identification: Males 67–80 mm, females 83–94 mm. This large brown treefrog with a long, pointed snout has a distinctive white labial stripe, dark brown face mask, large tympanum, and long limbs. The dorsum is tan, with darker transverse bars or chevrons and commonly a narrow middorsal dark stripe; the throat has dark brown spots bordered by white, and the chest is brown with cream spots. The iris is dull bronze. The skin on the dorsum is smooth. The outer fingers are webbed basally, and the toes are two-thirds webbed; males have a projecting spine on the thumb.

Similar species: No other large treefrog in the region has a long, pointed snout. *Hyla boans*, *H. geographica*, and the species of *Osteocephalus* also have long legs, but they have bluntly rounded snouts and lack the distinctive large spots on throat and a brown chest with cream spots.

Natural history: Arboreal and nocturnal, males can be heard almost every night, all year long, calling at the edge of open, shallow pools. The call is a loud “quack.” Clutches of 2100–2400 pigmented eggs 2 mm in diameter are deposited as a film on the surfaces of ponds. The eggs hatch in about three days. Tadpoles attain lengths of about 40 mm, of which the tail is about 70% of the length. The body is ovoid, wider than high; the eyes are widely separated and directed dorsolaterally. The tail fins are shallow, and the dorsal fin does not extend onto the body; the tail terminates in a point. The oral disc is anteroventral and folded laterally; the LTRF is $2(2)/3$. The body is dark brown above and gray below with small, green lichenous spots. The tail musculature is tan with vertical brown bars extending onto the fins.

Hyla leali Bokermann (Plate 3H)

Identification: Males 20–23 mm, females 23–26 mm. The body is elongate

with relatively short limbs, a truncate snout, and an axillary membrane. The fingers are short, and the outer fingers are less than one-third webbed; the toes are about two-thirds webbed. The dorsum is pinkish tan, usually with a brown X-shaped mark in the scapular region, and the venter is cream; the thighs are dull yellow. The iris is pinkish brown, and there is a white spot on the upper lip below the eye. Reproductive males have a large, yellow vocal sac and nuptial pads on the thumbs.

Similar species: *Hyla riveroi* is even smaller and has narrow brown lines in the scapular region, and *H. rossalleni* lacks the pale spot below the eye; *H. miyatai* has a reddish brown X-shaped dorsal mark, and *H. koechlini* has black flanks and thighs. *Hyla allenorum* and *H. parviceps* have dark venters and/or thighs, and *H. minuta* has distinctive white stripes on the heels and rump.

Natural history: This nocturnal, arboreal frog is associated with open and disturbed habitats. Commonly they call in large groups around temporary or semipermanent ponds at the edge of the forest. The call consists of two frequency-modulated pulsed notes; the second is shorter than the first. Clutches of 420–1106 pigmented eggs are deposited in ponds.

Hyla leucophyllata (Bereis) (Plate 4A–B)

Identification: Males 33–36 mm, females 40–44 mm. The skin on the dorsum is smooth the snout is truncate, and an extensive axillary membrane is present. The fingers are about one-half webbed, and the toes are two-thirds webbed. The dorsum is creamy yellow with a median, dark brown, hour-glass-shaped mark on the back; the sides of the head and flanks are brown; the hidden surfaces of the limbs and webbing are orange. The dorsal surface of the shank is creamy yellow with one or two narrow, transverse, brown bands. In some individuals the dorsum is dark brown with cream reticulations. The iris is dull bronze.

Similar species: Other frogs in the region that can be confused with *Hyla leucophyllata* are *H. bifurca* and *H. sarayacuensis*. The former is smaller and predominately brown above with narrow cream dorsolateral marks that extend to the middle of the body, whereas the dorsolateral marks in *H. sarayacuensis* are white or pale golden yellow, have irregular edges, and extend posterolaterally from the eyelids onto the flanks. *Hyla triangulum* is similar structurally but has red webbing and hidden surfaces of the limbs.

Natural history: This treefrog, which has a distinctive herbal odor, usually is found at night around ponds in the forest or open areas. Males call from emergent vegetation; the call is a harsh primary note followed by 2–7 shorter secondary notes. Clutches of about 600 lightly pigmented eggs about 1.5 mm in diameter are deposited on vegetation over water. Hatchling tadpoles

drop into the water and live mostly near the bottom of ponds. Tadpoles attain a length of 30 mm, of which the tail is about 70% of the length. In dorsal view the body is violin-shaped with a round snout. The tail fins are about equal in height, and the dorsal fin does not extend onto the body; the tail terminates in a slender filament. The oral disc is directed anteriorly and has large, blunt papillae laterally. The jaw sheaths are serrate, and labial teeth are absent. The dorsum of the body is chocolate brown, and the flanks and tail are black. A white stripe extends from the eye to the base of the tail, and the belly is black with longitudinal cream dashes.

Hyla marmorata (Laurenti) (Plate 5E)

Identification: Males 40–44 mm, females 50–56 mm. The snout is short and blunt; the skin on the dorsum is weakly tuberculate. The fingers are about two-thirds webbed, and the toes are webbed to the bases of the discs; scalloped dermal folds are present on the outer edges of the feet, forearms, and hands, and there is an extensive axillary membrane. The dorsum is mottled grayish green, reddish brown, and black, occasionally with white patches; the throat, belly, undersides of the hind limbs, axillary membranes, and webbing are creamy white to dull yellow with black spots or mottling. The iris is pale gray with black reticulations and usually a median horizontal reddish brown streak.

Similar species: This distinctive treefrog differs from all other frogs in the region by having scalloped dermal folds on the limbs and a yellow belly with black spots or mottling. The larger *Hyla tuberculosa* also has scalloped dermal folds on the limbs, but it has a coarsely tuberculate dorsum and plain venter.

Natural History: Nocturnal and arboreal, these frogs usually are in the trees, but after heavy rains males call from the ground, grasses, herbs, or bushes around temporary ponds. The call consists of 1–3 moderately long, pulsed, low-pitched notes produced at a rate of about 20 notes per min. Females deposit clutches of 740–1580 small (1.7 mm), pigmented eggs as a film on the surface of the water. The eggs hatch in 32–48 hr and develop into tadpoles attaining a length of about 25 mm, of which the tail is about two thirds of the length. The tail is high and terminates in a slender point. Smaller tadpoles have an olive-tan body with brown transverse marks; the throat is gray with brown flecks, and the belly is white. The tail is tan with brown spots anteriorly and black spots posteriorly. Larger tadpoles are green with brown blotches on the body and a reddish tan blotch dorsally on the body at the base of the tail. The mouth is terminal, and labial teeth are absent.

Hyla microderma Pyburn (Plate 4I)

Identification: Males 31–34 mm, females unknown. This slender frog has

long limbs and the head wider than the body. The snout is truncate. A small tubercular calcar is present on each heel. The fingers are unwebbed, and the toes are about one-half webbed. The eye is large with a horizontally elliptical pupil and creamy white iris with a dark periphery; the lower eyelid has pale golden reticulations. The dorsum is tan to reddish brown with narrow, dark brown, transverse marks and usually a middorsal line; transverse dark marks are present on the limbs. The flanks, hidden surfaces of the limbs, and venter are cream. The discs on the fingers and toes are bright yellow.

Similar species: *Hyla microderma* differs from all other brown treefrogs in the region by having distinctly bright yellow discs on the fingers and toes. Two large species, *H. boans* and *H. geographica*, also have golden reticulations on the lower eyelids, but these species have extensive webbing between the fingers and vertical dark markings on the flanks. *Hyla calcarata* and *H. fasciata* are similar to *H. microderma* in size and structure, but both lack reticulations on the lower eyelid and have black markings on the flanks and thighs.

Natural history: This nocturnal species inhabits primary forest, where males call from leaves 2–4 m above edges of swamps. The call is a trill consisting of 4–12 uniform notes. The eggs and tadpoles are unknown.

Hyla minuta Peters (Plate 3D)

Identification: Males 17–22 mm, females 21–24 mm. This small frog has smooth skin on the dorsum and no axillary membrane. The snout is bluntly rounded; the fingers are about one-half webbed, and the toes are two-thirds webbed. The dorsum is tan to reddish brown with irregular dark brown markings narrowly bordered by cream. The thighs are orange tan. A narrow, transverse cream stripe on the rump is confluent with cream stripes on the heels when the frog is in a resting position. The iris is reddish tan.

Similar species: The cream marks on the rump and heels readily distinguish this frog from any other small treefrogs in the region, except *Hyla bifurca*, which has cream dorsolateral stripes on the anterior part of the body.

Natural history: This frog usually is abundant in forest ponds and is commonly found in primary terra firme forest, where it feeds on ants. The call is a harsh primary note followed by 1–3 notes shorter notes repeated at a rate of 8–13 calls per minute. Clutches of lightly pigmented eggs are deposited on emergent vegetation in forest ponds and swamps. Tadpoles hatch after 5–7 days and fall into the water. Tadpoles attain lengths of 42 mm, 68% of which is tail. The body is ovoid with a broadly rounded snout; the eyes are large and lateral. The tail fins are twice as high as the musculature, and the tail terminates in a slender filament; the dorsal fin extends onto the body. The oral disc is directed anteriorly; the median part of the upper lip is bare,

whereas elsewhere the disc has two rows of small marginal papillae. The jaw sheaths are robust and finely serrate; the LTFR is 0/1–2. The body is brown above and laterally, whereas the venter is white with small ventrolateral brown flecks; the tail is cream with small brown blotches.

***Hyla miyatai* Vigle and Goberdham-Vigle (Plate 3B)**

Identification: Males 16–18 mm, females 20–21 mm. The skin on the dorsum is smooth, and the snout is short and truncate; the tympanum is small and barely discernible. The fingers are about one-third webbed, and the toes are about three-fourths webbed. The dorsum is metallic yellow with red markings consisting of a large triangle on the head and nape usually connected with a chevron-shaped mark in the scapular region, irregular marks posteriorly on the body, and irregular transverse marks on the limbs. The venter is pale pink, and the iris is pinkish tan.

Similar species: *Hyla rhodopepla* is the only other treefrog in the region that is yellow with red markings; this species is slightly larger and more slender than *H. miyatai* and has a creamy yellow dorsum with red flecks and dorsolateral stripes.

Natural history: This species calls from water hyacinths and bushes in shallow ponds and along slow-moving streams in, or at the edge of, forest. The call consists of a series of cricketlike chirps. The tadpoles are unknown.

***Hyla parviceps* Boulenger (Plate 3F)**

Identification: Males 15–18 mm, females 21–26 mm. The skin on the dorsum is smooth with scattered small tubercles; the snout is truncate. The fingers are about one-half webbed, and the toes are three-fourths webbed. The dorsum is tan to reddish brown with dark brown markings. A white suborbital bar is prominent. The thighs are black with one or two cream spots on the anterior surfaces. The venter is grayish white with a suffusion of black posteriorly on the belly; the ventral surfaces of the limbs are gray to black with a prominent orange spot on the proximal part of the shank. The iris is silvery gray with a red ring around the pupil.

Similar species: Other small treefrogs that have black thighs with pale spots differ by lacking an orange spot on the ventral surface of the shank.

Natural history: This small treefrog is locally common in primary and secondary forest, where it congregates to breed in swamps. Males call from emergent vegetation. The call is a series of short, high-pitched notes produced at a rate of about 55 notes per min. Clutches containing about 300 heavily pigmented eggs about 1.1 mm in diameter are deposited in clumps in ponds. Hatching occurs in two days. The tadpoles attain lengths of 19 mm, of which the tail is about 68%. The body is ovoid with a bluntly rounded

snout; the eyes are large and lateral. The tail fins are about equal in height and shallower than the musculature; the dorsal fin does not extend onto the body, and the tail terminates in a long filament. The oral disc is directed anteriorly; the median part of the upper lip is bare, but elsewhere the disc is bordered by large, blunt papillae. The robust jaw sheaths are finely serrated; labial teeth are absent. The body is dark brown with a broad, transverse cream bar on the snout and another posteriorly on the body; the tail is pale orange with dark brown mottling.

Hyla punctata (Schneider) (Plate 7B)

Identification: Males 31–40 mm, females 35–41 mm. The skin on the dorsum is smooth; the fingers are webbed only basally, and the toes are one-half webbed. Males lack projecting spines on the thumb. At night the dorsum is reddish tan and the flanks and limbs are green. By day, the dorsum is pale green with dark red flecks and a creamy yellow dorsolateral stripe bordered below by a narrow red stripe; some individuals have yellow blotches on the dorsum. The throat is green and the belly, white; the iris is white with dark reticulations.

Similar species: *Hyla granosa* is similar in size and general coloration, but it lacks dorsolateral stripes, and has granular skin on the dorsum, the fingers one-third webbed, and a spine on the thumb in males. *Sphaenorhynchus* are green but have a more extensive webbing and pointed snouts.

Natural history: This frog is common in permanent and semipermanent open ponds, where males call from the water surface amidst grassy areas. The call consist of 5–15 low pitched notes. Clutches of 230–430 pigmented eggs, about 1.5 mm in diameter are deposited in water. Tadpoles hatch in three or four days. Tadpoles attain lengths of 37.5 mm, of which the tail is about 70%. The body is ovoid and shallow with a rounded snout; the eyes are large and lateral. The tail musculature is slender and shallower than the fins; the dorsal fin is higher than the ventral fin and does not extend onto the body. The tail terminates in a point. The body is dark green with black flecks, and the belly is dark gray; the tail is olive green. The oral disc is anteroventral with lateral folds; except for the median part of the upper lip, it is bordered by a single row of papillae. The jaw sheaths are slender and finely serrated; the LTRF is 2(2)/3.

Hyla rhodopepla Günther (Plate 3C)

Identification: Males 20–23 mm, females 27–28 mm. The skin on the dorsum is smooth; the fingers are about one-third webbed, and the toes are one-half webbed. The dorsum is yellow (white by day) with red flecks and a broad, reddish brown lateral stripe and a white labial stripe. The venter is

yellow, and breeding males have a bright yellow vocal sac but lack nuptial pads on the thumbs. The iris is pinkish gray.

Similar species: *Hyla miyatai* also is yellow with red markings, but it is a smaller frog with a large X-shaped red mark in the scapular region and no lateral stripe. The pattern of some *H. riveroi* resembles that of *H. rhodopepla*, but the markings of this smaller frog are brown.

Natural history: An inhabitant of primary and secondary forest, individuals congregate at small ponds for breeding. Males call from emergent vegetation; the call is a moderately high-pitched primary note followed by 3–5 shorter secondary notes. Clutches of about 350 heavily pigmented eggs about 1.1 mm in diameter are laid in water; the eggs hatch in 2 or 3 days. Tadpoles attain lengths of about 17 mm, of which 70% is tail. The body is ovoid with a broadly rounded snout and large, lateral eyes. The tail fins are high, and the dorsal fin extends onto the body; the tail terminates in a long filament. The oral disc is anterior and lacks lateral folds, papillae, and labial teeth; the jaw sheaths are robust and weakly serrate. The body and tail are pale orange with scattered brown flecks.

Hyla riveroi Cochran and Goin (Plate 3I)

Identification: Males 19–20 mm, females 22–23 mm. The head is large with a round snout, and the body and limbs are relatively short; the skin on the dorsum is smooth, and an extensive axillary membrane is present. The fingers are one-fourth webbed, and the feet are two-thirds webbed. The dorsum is yellow to pale tan with tan or brown markings consisting of canthal and supratympanic stripes, transverse bars on the limbs, and flecks and usually longitudinal dark marks in the occipital-scapular region on the back. Two or three creamy yellow spots are present below the eye. The venter is white; males have a yellow vocal sac and lack nuptial pads on the thumbs. The iris is reddish bronze.

Similar species: This small treefrog is most easily confused with *Hyla leali* and *H. rossalleni*. The latter lacks the spots below the eye, and *H. leali* has only one spot below the eye and usually an X-shaped mark in the scapular region. *Hyla koechlini*, *H. allenorum*, and *H. parviceps* have dark venters and/or thighs, and *H. minuta* has distinctive white stripes on the heels and rump.

Natural history: This small treefrog inhabits secondary and primary forest and congregates for breeding in temporary ponds, where males call from emergent vegetation. The call is a series of short, insectlike notes repeated at a rate of about 40 notes per min. Eggs presumably are deposited in the water; tadpoles are unknown.

Hyla rossalleni Goin (Plate 3J)

Identification: Males 18–20 mm; females 22–23 mm. The skin on the dorsum is smooth, and the snout is round; an extensive axillary membrane is present. The fingers are one-half webbed, and the toes are three-fourths webbed. The dorsum is yellowish tan with brown markings, usually in the form of an interorbital bar, chevrons on the back, and transverse bars on the limbs. The venter is white, and the iris is pale metallic red. Males have a yellow vocal sac and lack nuptial pads on the thumbs.

Similar species: This small treefrog is most easily confused with *Hyla leali* and *H. riveroi*, both of which have less webbing and have spots below the eye. Of the other small treefrogs in the region, *Hyla allenorum*, *koechlini*, and *parviceps* have dark venters and/or thighs, and *H. minuta* has distinctive white stripes on the heels and rump.

Natural history: Individuals have been encountered in primary and secondary forest. The reproductive habits, call, and tadpoles are unknown.

Hyla sarayacuensis Shreve (Plate 4D)

Identification: Males 24–29 mm, females 34–37 mm. The skin on the dorsum is smooth, and an axillary membrane is present. The fingers are one-half, and the toes two-thirds, webbed. The dorsum is mottled dark and pale brown with creamy white to golden yellow markings with irregular edges—broad mark on the snout, a diagonal mark from the eyelid to midflank, and diagonal marks on the shanks. The hands, feet, hidden surfaces of the limbs, and the ventral surfaces of the limbs are orange. The iris is coppery bronze. Males have a yellow vocal sac and no nuptial pads on the thumbs.

Similar species: Other frogs in the region that can be confused with *Hyla sarayacuensis* are *H. bifurca* and *H. leucophyllata*. The former is predominately brown above with narrow cream dorsolateral marks that extend to the middle of the body, whereas *H. leucophyllata* is predominately creamy tan with a dark brown hourglass-shaped mark on the back. *Hyla triangulum* is similar structurally but has red webbing and hidden surfaces of the limbs.

Natural history: This nocturnal, arboreal species with a distinctive herbal odor inhabits primary and secondary forest, where adults breed in ponds. Males call from low vegetation in and around ponds; the call is a harsh primary note usually followed by one or two shorter notes. Gravid females deposit 68–176 lightly pigmented eggs about 2 mm in diameter in several clutches on the upper surfaces of leaves over water. Tadpoles attain lengths of 22.5 mm, of which 70% is tail. In dorsal view the body is violin-shaped with a bluntly rounded snout; the eyes are large and lateral. The ventral tail fin is slightly higher than the dorsal fin, which does not extend onto the body; the tail terminates in a long filament. The oral disc is anterior and is

bordered laterally and ventrally by a single row of papillae. The jaw sheaths are robust and finely serrated; labial teeth are absent. The body is reddish brown to gray, and the belly is metallic gold; the tail is black or gray with black reticulations.

Hyla triangulum Günther (Plate 4E–F)

Identification: Males 24–28 mm, females 36–42 mm. The skin on the dorsum is smooth; an extensive axillary membrane is present. The fingers are one-half, and the toes three-fourths, webbed. The dorsal pattern varies from immaculate cream or tan to reddish brown with one to many round brown spots; some individuals have a pale reticulated pattern on the dorsum. The webbing and hidden surfaces of the limbs are red. The iris is coppery bronze. Males lack nuptial pads on the thumbs.

Similar species: *Hyla bifurca*, *H. sarayacuensis*, and some *H. leucophyllata* have similar dorsal patterns, but the webbing and hidden surfaces of the thighs are orange. The only other frog in the area having red webbing is the much larger *Phrynohyas coriacea*, which has a bluish-black postorbital mark, a large middorsal dark brown quadrangular mark, and thick pustular skin on the dorsum.

Natural history: Although *Hyla triangulum* occurs in secondary forest, it most commonly is found around temporary ponds in clearings near forest. The call consists of a harsh primary note followed by 2–6 shorter notes. Clutches of about 550 heavily pigmented eggs 1.6 mm in diameter are laid on vegetation above shallow water. Tadpoles attain lengths of 17 mm, two-thirds of which is tail. In dorsal view the body is violin-shaped with a broadly rounded snout; the eyes are large and lateral. The ventral tail fin is higher than the dorsal fin, which does not extend onto the body; the tail terminates in a long filament. The oral disc is anterior; it is bordered by a fleshy fold laterally and ventrally. The jaw sheaths are moderately robust and finely serrate; labial teeth are absent.

Hyla tuberculosa Boulenger (Plate 5F)

Identification: Males 73–90 mm, females 69–79 mm. The snout is short and blunt; the skin on the dorsum is coarsely tuberculate, and that on the venter is granular. The upper edge of the tympanum is covered by a thick fold. The fingers are about three-fourths webbed and the toes nearly fully webbed. Scalloped dermal folds in the form of series of triangular appendages are present on the outer edges of the hands, forearms, and feet. The dorsum is pale tan to grayish green with indistinct, irregular darker markings. The venter is greenish cream. The iris is pale silvery gray.

Similar species: The only other frogs in the region with extensive dermal folds on the limbs are *Hyla marmorata* and *Agalychnis craspedopus*. The

former has weakly tuberculate skin on the dorsum and a white and yellow venter with black spots. The latter is dark green dorsally and has yellow bars on the flanks and a vertically elliptical pupil. Other treefrogs with similar coloration and at least some tubercles on the dorsum are smaller and have the fingers one-third webbed (*Osteocephalus buckleyi*) or unwebbed (*Scinax funerea* and *S. garbei*).

Natural history: Solitary individuals have been observed on branches of trees in primary forest. The call, eggs, and tadpoles are unknown.

BROAD-HEADED TREEFROGS (GENERA *OSTEOCEPHALUS* AND *PHRYNOHYAS*)

In one group of large, mostly brown treefrogs with broad heads and extensive webbing on the feet, males have large nuptial pads on the thumbs and paired, lateral vocal sacs behind the angles of the jaws. The skin on the dorsum is smooth in females and tubercular in males of *Osteocephalus* and thick and glandular in both sexes in *Phrynohyas*. These frogs, especially *Phrynohyas*, exude a white secretion that can be extremely irritating to human skin and mucous membranes. All species are nocturnal and arboreal. The known tadpoles have ovoid bodies, anteroventral oral discs, slender and finely serrate jaw sheaths, and tails that terminate in a point.

Osteocephalus buckleyi (Boulenger) (Plate 5G)

Identification: Males 38–48 mm, females 49–57 mm. The skin on the dorsum has a mixture of large and small tubercles in males and scattered tubercles in females, and the skin on the anterior part of the flank is elevated amidst a network of depressions; the snout is truncate, and the tympanum is about two-thirds the size of the eye. The fingers are about one-third webbed, and the toes are about two-thirds webbed; prominent tubercles are present on the outer edges of the forearms and feet. The dorsum is green or gray with irregular darker green or dull brown blotches; the venter is grayish brown; the flanks are cream to tan with tan to black blotches, and the thighs are brown. The iris is golden or greenish bronze with black flecks.

Similar species: The other species of *Osteocephalus* have a brown dorsum; the only other green treefrogs in the region that have a tuberculate dorsum are *Scinax garbei*, which has a pointed snout and black and red bars on the thighs, *Scinax funerea*, which has yellow flanks and hidden surfaces of the hind limbs with brown stripes or dashes, and the much larger *Hyla tuberculosa*, which has the fingers about three-fourths webbed and dermal fringes on the limbs.

Natural history: Little is known about this arboreal inhabitant of primary forest. Males call from forest ponds. The tadpoles are unknown.

Osteocephalus lepreurii (Duméril and Bibron) (Plate 5I)

Identification: Males 41–48 mm, females 47–62 mm. The skin on the dorsum is smooth in females and bears small, spinous tubercles in males; the snout is truncate, and the head is nearly as wide as long. The tympanum is about three-fourths the size of the eye. The fingers are about one-fourth, and the toes three-fourths, webbed. The dorsum is tan to chestnut brown with alternating broad and narrow transverse dark brown bars on the body and limbs; a broad cream labial stripe is expanded below the eye, and the venter is white to pale salmon. The iris is greenish bronze with black reticulations.

Similar species: The only other treefrog in the region with transverse dark markings on a tan dorsum is *Hyla lanciformis*, which has a pointed snout, smooth skin on the dorsum in both sexes, and a brown chest with white spots.

Natural history: This frog usually is found on branches of trees in primary forest. Breeding occurs in temporary ponds, where males call from bushes and branches of trees at the edge of the water. The call is a soft, rattling chuckle. Small, pigmented eggs are deposited as a film on the surface of the water. Tadpoles are unknown.

Osteocephalus taurinus Steindachner (Plate 5J)

Identification: Males 66–85 mm, females 76–103 mm. The skin on the dorsum is smooth in females and bears large, spinous tubercles in males; in large individuals the skin on the top of the head is fused with the underlying bones, which form a pair of longitudinal ridges between the eyes. The snout is bluntly rounded, and the head is nearly as wide as long. The tympanum is about three fourths the diameter of the eye. The fingers are about one-half, and the toes four-fifths, webbed. The dorsum is tan to reddish brown with dark brown irregular markings on the back and transverse bars on the limbs. The flanks are tan to creamy white with dark brown spots. The venter is cream, usually with brown spots or mottling on the chest. The iris is greenish bronze with radiating black lines.

Similar species: *Hyla boans* and *H. geographica* are similar in size and coloration, but both sexes have smooth skin on the dorsum, small calcars on the heels, and reticulated lower eyelids. Some individuals of *Phrynohyas venulosa* and *P. resinifictrix* have similar dorsal coloration, but these frogs have thick, glandular skin on the dorsum, which bears many large tubercles in *P. resinifictrix*.

Natural history: At night, this large treefrog usually is seen perched cross-wise on trunks of small trees and vines in primary and secondary forest. After heavy rains breeding takes place in temporary ponds, where males usually call while floating on the surface of the water. The call is a loud

“boop-boop-boop,” followed or not by a “worrrr.” Small, heavily pigmented eggs are deposited as a film on the surface of the water. Tadpoles attain lengths of 35 mm. The body is ovoid, and the large eyes are directed dorsolaterally; the at midlength of the tail the fins are about as high as the musculature; the dorsal fin does not extend onto the body. Except for the median part of the upper lip, the disc is bordered by a single row of small papillae; the LTRF is (2–3(3)/5(1). The body and tail are tan with brown reticulations on the tail.

Osteocephalus species (Plate 5H)

Identification: Males 41–45 mm, females 45–50 mm. The skin on the dorsum is smooth and in males bears scattered small tubercles. The head is slightly longer than wide, and the snout is bluntly rounded. A pair of bony, longitudinal crests are present between the eyes; the tympanum is about three fifths the diameter of the eye. The fingers are webbed basally, and the toes are about three-fourths webbed. The dorsum is tan or brown with dark brown spots and bars on the limbs. The flanks are tan, and the hidden surfaces of the limbs are brown; the venter is creamy yellow, and the margin of the upper lip is cream to bronze-tan. The iris is bronze with radiating black lines; the bones are white.

Similar species: All other species of broad-headed treefrogs in the region have green bones, and all are larger, except *Osteocephalus buckleyi*, which is primarily green with mixed large and small tubercles on the dorsum.

Natural history: This treefrog inhabits arboreal bromeliads in primary forest. Males call from bromeliads; the call is a multiphasic series of chucklelike notes. Eggs are deposited in water in bromeliads, and the tadpoles develop there. Apparently, the mother returns to the bromeliad periodically and deposits infertile eggs that provide the chief food for the tadpoles.

Phrynohyas coriacea (Peters) (Plate 8A)

Identification: Males 54–63 mm, females 57–66 mm. The skin on the dorsum is thick and glandular but smooth; a heavy glandular fold covers the upper part of the tympanum, which is about three fourths the size of the eye. The snout is broad and rounded; the fingers are about one-half, and the toes three-fourths, webbed. The dorsum is tan to reddish brown, usually with a large rectangular blotch narrowly outlined with cream. A large purple or bluish black spot is present above the insertion of the arm. The venter is cream, and the hidden surfaces of the thighs and webbing are red. The iris is dark bronze.

Similar species: *Phrynohyas resinificatrix* has a conspicuously tuberculate dorsum; both it and *P. venulosa* lack red on the thighs and webs. The only

other frog in the region having red webbing is the much smaller *Hyla triangulum*, which lacks the thick, glandular skin on the dorsum and the purple or black spot above the insertion of the arm.

Natural history: This species inhabits primary forest. After the first heavy rains of the season, explosive breeding occurs in temporary forest ponds. Males call while floating on the surface of the water, and the call is a single, loud growl. About 1500 brown eggs about 2 mm in diameter are deposited as a film on the surface. Tadpoles attain a length of 38 mm. The body is ovoid, much broader than deep, and the large eyes are directed laterally. The tail fins are higher than the tail musculature, which terminates in an attenuated tip; the fins do not extend to the tip of the tail, and the dorsal fin extends onto the body. Except for the median part of the upper lip, the oral disc is bordered by a single row of small papillae; the LTRF is 3(3)/5(1). The body is tan and the belly silvery white; the tail is creamy yellow with black stripes dorsally, ventrally, and midlaterally.

Phrynohyas resinifictrix (Goeldi) (Plate 8B)

Identification: Males and females to 76 mm. The skin on the dorsum is thick, glandular, and bedecked with many large, blunt tubercles. The snout is bluntly rounded, and the fingers are about three-fourths, and the toes four-fifths webbed. The dorsum is tan to greenish gray with brown markings—irregular marks on the back, transverse bars on the limbs, and spots on the flanks. A broad, pale interorbital bar usually is present. The venter is dull cream. The iris is golden bronze with four radiating black lines.

Similar species: No other treefrog in the region has such a tuberculate dorsum; the tubercles in males of *Osteocephalus* are smaller and spinous.

Natural history: This frog inhabits primary forest, where they breed in tree cavities and may seldom, if ever, descend to the ground. Apparently the frogs occur in low densities (one male per 20–25 hectares). Males call from inside tree cavities, the call is a loud barklike note. More than 1000 eggs are laid in water in treeholes. Tadpoles can reach 38.7 mm; body is ovoid, dark olive brown above with a silver belly and transparent tail fins; the LTRF is 2(2)/3–5. The tadpoles feed on detritus and fertilized eggs of their own species.

Phrynohyas venulosa (Laurenti) (Plate 8C)

Identification: Males 85–93 mm, females 103–110 mm. The skin on the dorsum is smooth, thick, and glandular, with or without scattered low tubercles; the snout is broadly rounded. The fingers are one-half, and the toes, three-fourths webbed; the discs are large and round. The dorsum is tan to reddish brown; most individuals have one or more large dark brown marks on the back and transverse bars on the limbs, but some have only small

brown spots or are unicolor. The venter is dull cream. The iris is deep golden bronze heavily flecked with black.

Similar species: *Phrynohyas coriacea* has a purple or bluish black mark above the insertion of the arm and orange webbing, and *P. resinifictrix* has large tubercles on the dorsum. Males of *Osteocephalus* have spinous skin on the dorsum.

Natural history: Usually perched on branches of trees in primary and secondary forest, this species descends to temporary ponds after heavy rains. Males call from branches of low bushes or while floating on the surface of the water. The call is a loud growl repeated at short intervals. Pigmented eggs are deposited as a film on the surface of the pond. Tadpoles attain a length of 49 mm. The body is ovoid, slightly deeper than wide; the large eyes are directed laterally. The tail musculature is slender and gradually diminishes to a slender tip. The tail fins are moderately high and extend to the tip of the tail; the ventral fin is slightly higher than the dorsal fin, which extends onto the body. There are two rows of labial papillae, and the LTRF is 4(4)/6(1); usually the two outermost rows on both lips are fragmented. The body is dark olive brown, and the belly is white; the tail is creamy yellow with a brown lateral stripe and brown flecks on the fins.

LEAF FROGS (GENERA *AGALYCHNIS* AND *PHYLLOMEDUSA*)

These nocturnal, slow-moving treefrogs have vertically elliptical pupils. *Phyllomedusa* have large feet devoid of webbing, and the first finger and first toe are longer than, and opposable to, the second ones. Males have a single, median, subgular vocal sac and nuptial pads on the thumbs. With the exception of *P. atelopoides*, all are arboreal and have a green dorsum. The call of these nocturnal frogs is a single note, "cluck" or "wort." The relatively large, unpigmented eggs are deposited in clumps on vegetation overhanging water; usually the eggs are encased in a leaf folded by the female after oviposition. The tadpoles are pelagic and usually are oriented head upward at an angle of about 45° to the surface of the water. Tadpoles have elongately ovoid bodies with truncate snouts and large, lateral eyes; the tail has shallow fins and terminates in a slender point. The oral disc is terminal and except for the median part of the upper lip, the disc is bordered by one or two rows of small papillae; the LTRF is 2(2)/3(1). These frogs have a distinctive odor; when handled, they commonly feign death by withdrawing the limbs under the body and hunching the head and body.

Agalychnis craspedopus (Funkhouser) (Plate 6A)

Identification: Males 55–57 mm, females 69–73 mm. This frog has conspicuous dermal fringes on the lips and shanks. The fingers lack webbing

but the toes are four-fifths webbed; discs on the digits are large and round. The dorsum is lavender green with scattered, irregular, lichenous, grayish white spots; the granular venter and all ventral surfaces of fringes are bright yellow or orange-yellow. The flanks are yellow with 6–8 vertical brown bars. The iris is grayish white with fine black reticulations; the lower eyelid is dark green with irregular pale green and silver reticulations.

Similar species: Other frogs in the region with vertically elliptical pupils are species of *Phyllomedusa*, most of which have a green dorsum, but these frogs lack webbing on the feet. The only other green frog with extensive dermal fringes on the limbs is *Hyla tuberculosa*, which has a coarsely tuberculate dorsum and horizontally elliptical pupil.

Natural history: This frog inhabits high trees in primary forest, but they descend to low branches to breed. The call is a soft “cluck.” Clutches of 14–21 eggs, 4 mm in diameter with a large capsule (total diameter about 12 mm), are deposited on vegetation overhanging water-filled cavities in logs. Tadpoles attain lengths of 45–65 mm. The body is dark gray to black, and the tail is black with blue-gray spots.

***Phyllomedusa atelopoides* Duellman, Cadle, and Cannatella
(Plate 6B)**

Identification: Males 36–37 mm, females 40–45 mm. The skin on the dorsum is smooth, and the snout is bluntly rounded in dorsal view and truncate in profile. The discs on the fingers and toes are small. The limbs are relatively short, and the parotoid gland is diffuse. The dorsum is purplish brown with scattered metallic green flecks; the flanks and ventral surfaces are bluish white with dark purple between the granules. The iris is silvery gray with black flecks.

Similar species: All other *Phyllomedusa* in the area are green and arboreal; furthermore, they all have either stripes, bars, or round spots on the flanks.

Natural history: This terrestrial frog is active on the ground or on low vegetation in primary forest at night. The call is a single “wort.” The only known clutch contained 20 eggs 3 mm in diameter encased in a leaf. Fully developed tadpoles are unknown.

***Phyllomedusa bicolor* (Boddaert) (Plate 6G–H)**

Identification: Males 91–103 mm; females 111–119 mm. The skin on the dorsum is rough, and the snout is slightly inclined anteriorly. The discs are large. The parotoid glands are elevated, rounded, protruding dorsolaterally, and extend nearly the full length of the body. The dorsum and sides of the head are green; the flanks and hidden surfaces of the thighs are reddish brown with cream spots bordered by black. The throat, chest, and ventral surfaces

of the limbs are gray; other ventral surfaces are pale orange. The iris is silvery gray.

Similar species: *Phyllomedusa tarsius* is nearly as large, but it has reddish copper and black eyes; other species of *Phyllomedusa* on the Iquitos region differ in pattern and color on back and flanks and by having the first toe longer than the second.

Natural history: Nocturnal and highly arboreal, *P. bicolor* lives in primary and secondary forest. Males call from branches as high as 8 or more meters above the ground and descending to 1–2 m above ponds to mate; the call is a loud “cluck” followed by several short, lower-pitched notes. Clutches contain about 250 eggs. Tadpoles attain lengths of 51 mm. The body and tail are translucent orange, and the belly is silvery white; the ventral fin has a dark border. Skin secretions of adult frogs contain a variety of vasoactive and opioid peptides; dried secretions mixed with human saliva are introduced into the blood stream through deliberate breaks in the skin by Panoan-speaking groups of Amazon Indians, who experience pain and gastric distress prior to feeling energized and refreshed.

Phyllomedusa palliata Peters (Plate 6C)

Identification: Males 38–44 mm, females 39–49 mm. The skin on the dorsum is smooth, and the snout is rounded in males and slightly inclined anteriorly in females. The discs are small. The parotoid glands are low, rounded, and extend to the shoulder. The dorsum and side of head, above the level of the nostrils and middle of orbit, are dark green; the lower side of the head, flanks, hidden surfaces of the limbs, and ventral surfaces are cream with brown flecks. The iris is bronze with black flecks.

Similar species: This is the only *Phyllomedusa* in the region having a lateral cream band with brown flecks. *Phyllomedusa tomopterna* has orange flanks and hidden surfaces of the limbs with distinct vertical brown bars; it also has calcars on the heels.

Natural history: This species inhabits the forested areas and reproduces in swamps and ponds, where males usually call from low vegetation. The call is a soft “cluck.” Clutches of 38–71 eggs, 3.5–4.0 mm in diameter, are laid on vegetation. Tadpoles attain lengths of 48 mm. The body and tail are bluish gray with an iridescent bluish green tint on the belly.

Phyllomedusa tarsius (Cope) (Plate 6E–F)

Identification: Males 81–90 mm, females 99–112 mm. The skin on the dorsum is slightly roughened, and large adults have tubercles on the hind limbs; the snout is inclined anteroventrally. The discs are large on the fingers, smaller on the toes. The parotoid glands are rounded, and extend at least to midbody.

The dorsum and side of the head are green; the flanks and hidden surfaces of the limbs are green with small cream, pink, or pale orange spots. The throat, chest, and ventral surfaces of the limbs are brown; the rest of the venter is pale gray or orange. The iris is bright orange-red with bold black reticulations.

Similar species: Because of its iris color, this species cannot be confused with any other *Phyllomedusa* in the region. *Phyllomedusa bicolor* is comparable in size but it has silvery gray iris, and the spots on the flanks are bordered by black.

Natural history: Nocturnal and arboreal, this treefrog inhabits primary and secondary forests. Males usually call from branches several meters above the ground and overhanging swamps; the call is a loud, low-pitched “cluck.” Clutches of about 550 eggs up to 4 mm in diameter are deposited on a leaf that usually is subsequently folded by the female. The eggs hatch in seven or eight days. Tadpoles attain lengths of 50 mm and are pale tan above and metallic green on the flanks and venter.

Phyllomedusa tomopterna (Cope) (Plate 6D)

Identification: Males 40–48 mm, females 52–59 mm. The skin on the dorsum is smooth; the snout is truncate in males and rounded in females. The discs are large. The parotoid glands are diffuse, and a triangular calcar is present on the heel. The dorsum and side of the head are green; the flanks and hidden surfaces of the limbs are orange with vertical purplish brown bars. The throat and chest are white, and the belly is pale orange. The iris is silvery gray.

Similar species: This frog differs from other *Phyllomedusa* by having vertical brown bars on the flanks and hidden surfaces of the limbs. The only other species with a vertical pupil, silver iris, and vertical bars on flanks is *Agalychnis craspedopus*, which has webbed feet.

Natural history: Nocturnal and arboreal, this frog breeds in a variety of forest environments—large swamps, ponds, small pools, and in water-filled cavities in logs. The call is a soft “cluck.” Clutches of 47–71 unpigmented eggs 3.5 mm in diameter are encased in leaves over water; eggs hatch in 10–12 days. Tadpoles attain lengths of 64 mm. The body and tail are yellowish tan with a diffuse orange spot posteriorly on the ventral fin; the belly is white.

Phyllomedusa vaillanti Boulenger (Plate 6I–J)

Identification: Males 50–58 mm, females 68–84 mm. The skin on the dorsum is roughened, and the hind limbs of adults are tuberculate; the snout is truncate in males and inclined anteroventrally in females. The discs are mod-

erately large. The parotoid glands are slightly elevated, angular, and extend at least to midbody, with a longitudinal row of white granules along the angle of the gland. The dorsum and side of the head are green; the flanks are green above and reddish brown below with a row of elliptical cream to orange spots. The venter is grayish brown with a pair of cream spots on the throat and a large green spot on the chest. The iris is pale gray.

Similar species: The nature of the parotoid gland with a row of white granules and the ventral color pattern immediately distinguish this species from all others in the region.

Natural history: Nocturnal and arboreal, this species congregates at forest ponds to breed. Males call from bushes over the water; the call is a short, harsh "cluck." A clutch of 645 eggs 2 mm in diameter was deposited on a leaf over water. Tadpoles attain lengths of 52 mm. The dorsum is olive green; the belly is white, and the ventrolateral surfaces are iridescent greenish yellow.

NARROW-HEADED TREEFROGS (GENERA *SCARTHYLE* AND *SCINAX*)

These small to medium-sized treefrogs have relatively narrow heads and long snouts. The skin on the belly is granular. Webbing is absent on the hand; with the exception of basal webbing between the innermost toes, the toes are one-half to three-fourths webbed (all toes nearly fully webbed in *Scarthyla*). The tympanum is distinct, and the pupil is horizontally elliptical. Males have a single, median, subgular vocal sac and lack nuptial pads on the thumbs. Insofar as is known, pigmented eggs are deposited on the surfaces of ponds. The tadpoles of *Scinax* have an ovoid body that is deepest posteriorly and a broadly rounded snout. The tail accounts for about 70 percent of the length; it is highest at about midlength and terminates in a point. The ventral fin is higher than the dorsal fin, which extends onto the body. The oral disc is anteroventral and has lateral folds and a single row of small marginal papillae, except on the median part of the upper lip, which is bare. The jaw sheaths are robust and finely serrate, and the LTRF is 2(2)/3.

Scarthyla ostinodactyla Duellman and de Sá (Plate 7G)

Identification: Males 17–21 mm, females 20–23 mm. The body is slender, and the legs are long; the snout is pointed and protrudes anteriorly beyond the mouth. The fingers are long and unwebbed, whereas the toes are almost fully webbed. The dorsum is pale green to tan with faint longitudinal brown marks; a narrow, bright, white stripe on the upper lip continues onto the flanks to the groin and is bordered above by a broader brown stripe. The throat is pale green, and the belly is white; the iris is reddish copper.

Similar species: *Colostethus* also has a brown lateral stripe but has a broader,

truncate snout, unwebbed feet, and has a tan dorsum.

Natural history: This small treefrog calls during the day and night from low vegetation in flooded forest. Adults are capable of skittering across the surface of the water. The call is a series of 8–10 short whistle-like notes. Gravid females 130–198 heavily pigmented eggs; presumably the eggs are deposited in water. Tadpoles attain lengths of about 24 mm; the tail is about twice as long as the elongate, shallow body. The tail musculature is robust, and the tail terminates in a point; the upper fin is much shallower than the lower one. The oral disc is terminal with flap-like lips bearing pointed papillae laterally; the LTRF is 2(1,2)/2(1). The body and tail are pale yellowish green with brown markings, and the belly is silvery white. Tadpoles swim just below the surface in duckweed-covered ponds and are capable of propelling themselves upward through the duckweed and into the air.

Scinax cruentomma (Duellman) (Plate 7C)

Identification: Males 25–27 mm, females 26–31 mm. The skin on the dorsum is smooth or slightly roughened; the snout is rounded. Tubercles are absent on the lips and heels; the discs are round. The dorsum is tan or brown, usually with darker brown longitudinal markings. The flanks are cream to tan with or without black spots, and the hidden surfaces of the thighs are tan to brown. The iris is silvery bronze with a median horizontal red streak.

Similar species: This species is most easily confused with *Scinax rubra*, which has black and yellow mottling in the groin and on the hidden surfaces of the hind limbs, but it, like all other treefrogs in the region, except *S. garbei*, lacks the red streak in the eye. *Scinax garbei* has a pointed snout and red and black bars on the hidden surfaces of the thighs.

Natural history: This frog is found in forest and clearings. Breeding occurs in temporary ponds, where males call, usually head down, on leaves or blades of grass above water. The call is a single, moderately long, soft note. Clutches of 600–1200 small, pigmented eggs are laid as a film on the surface of the water; they hatch in about 38 hours. Tadpoles attain a length of about 30 mm. The body is olive green with a brown streak from the snout to the eye; the belly is white with a silvery sheen, and the tail is pale yellow with brown flecks. A red streak is evident in the iris.

Scinax funerea (Cope) (Plate 7E)

Identification: Males 30–37 mm, females 31–38 mm. The skin on the dorsum is tuberculate; the snout is rounded. Large tubercles are absent on the lips and heels, and the discs are round. The dorsum is green or greenish tan with dark brown markings—interorbital bar, pairs of elongate marks on body, and spots corresponding to tubercles. The flanks and hidden surfaces of the

thighs are dull yellow with brown stripes or dashes. The iris is greenish bronze with brown flecks.

Similar species: *Scinax garbei* is larger and has a pointed snout and red and black bars on the thighs. *Osteocephalus buckleyi* is larger and has cream flanks with large dark spots and uniformly brown thighs. *Hyla tuberculosa* is much larger and has a coarsely tuberculate dorsum, fingers about three-fourths webbed, and dermal fringes on the limbs.

Natural history: This arboreal species occurs in primary and secondary forest. Adults are extremely wary and commonly evade capture by running up tree trunks. Breeding takes place in ponds in the forest, where males call from low vegetation. The call is a single, moderately long, rather high-pitched note. Clutches of 225–740 pigmented eggs are laid as a surface film on the water. Tadpoles attain lengths of 25 mm. The body is yellowish green; the belly is silvery cream, and the tail is pale orange with brown flecks.

Scinax garbei (Miranda-Ribeiro) (Plate 7F)

Identification: Males 30–42 mm, females 38–48 mm. The skin on the dorsum is smooth, usually with scattered conical tubercles; the snout is pointed. Conical tubercles are present on the margin of the lip, along the outer edges of the limbs, and on the heels; the discs are truncate. The dorsum is dull green or brown with dark brown markings—large triangular mark on head, bars on lips, large crescent-shaped marks in shoulder region, and transverse marks posteriorly. The flanks are cream with brown flecks, and the hidden surfaces of the thighs are dark red with vertical black bars. The iris is creamy bronze with a median horizontal reddish brown streak.

Similar species: The only other treefrog in the region with a red streak in the eye is *Scinax cruentomma*, which is smaller, has a rounded snout, and lacks red and black bars on the thighs. *Scinax funerea* and *Osteocephalus buckleyi* also have tuberculate skin on the dorsum, but both have rounded snouts and different colored thighs. *Hyla tuberculosa* is much larger and has a coarsely tuberculate dorsum, fingers about three-fourths webbed, and dermal fringes on the limbs.

Natural history: An arboreal species, *Scinax garbei* is most common in secondary forest and forest edge situations. Breeding occurs in open ponds, where males call head down on vegetation over water. The call is a moderately long “wraaak.” Clutches of 445–705 small, pigmented eggs are deposited as a surface film on the water; the eggs hatch in 55–79 hours. Tadpoles attain lengths of about 30 mm and are unique among the species in the region by having the lowermost row of labial teeth on a protuberance beyond the margin of the lower lip. The body is pale yellowish green, and the belly is silvery white; the tail is pale yellowish green with olive green transverse marks on the musculature and red flecks on the dorsal fin.

Scinax rubra (Laurenti) (Plate 7D)

Identification: Males 29–41 mm, females 37–44 mm. The skin on the dorsum is smooth or slightly roughened; the snout is rounded. Tubercles are absent on the lips and heels, and the discs are round. The dorsum is tan or pale dull green; a wide creamy tan to yellow dorsolateral stripe with dark borders usually is evident. The flanks are cream with yellow spots edged in black in the groin; the hidden surfaces of the thighs have yellow spots with black edges. The iris is bronze with black reticulations.

Similar species: *Scinax cruentomma* lacks the yellow spots in the groin and on the hind limbs and has a red streak through the eye. Other frogs in the region that have yellow spots on the posterior surfaces of the thighs are members of the genus *Eleutherodactylus* that differ by having smooth skin on the belly.

Natural history: Although this species may be observed on bushes and trees in secondary forest, it is most common in clearings, where individuals take refuge under logs, leaves, and clumps of grass. It commonly enters houses. This frog is extremely wary and leaps into dense vegetation or runs across the ground or up trees to avoid capture. Breeding occurs in shallow, temporary ponds, where males call from bushes, herbs, or grasses above the water. The call is a series of short notes, “aah-aah-aah.” Clutches of 705–807 small, pigmented eggs are deposited as a film on the surface of the water; hatching occurs in 48–55 hours. Tadpoles attain lengths of about 25 mm. The body is iridescent silvery gold laterally and ventrally with a brown streak from the snout to the eye; the dorsum and tail are yellowish tan with darker brown flecks.

HATCHET-FACED TREEFROGS, *SPHAENORHYNCHUS*

The name is applied to these frogs because in lateral view the snout is sharply inclined posteroventrally. The skin on the dorsum is smooth, and that on the belly is granular; the tympanum is indistinct. The pupil is horizontally elliptical. The hands and feet are webbed; males have a huge, median, subgular vocal sac and nuptial pads on the thumbs. These frogs feed exclusively on ants. Breeding takes place in ponds where eggs are deposited amidst vegetation in water. The tadpoles have ovoid bodies and tails that terminate in an attenuated tip. The fins are higher than the musculature at midlength of the tail, and the dorsal fin does not extend onto the body. The oral disc is small and subterminal; there is a single row of marginal papillae except for a wide gap on the upper lip. The jaw sheaths are slender and finely serrate, and the LTRF is 2(2)/3(1).

***Sphaenorhynchus carneus* (Cope) (Plate 7H)**

Identification: Males 15–18 mm, females 22–23 mm. The snout is narrowly truncate in dorsal view. The fingers are about one-third, and the toes three-fourths webbed. At night, the dorsum is pale green with yellow canthal and dorsolateral stripes; by day, the dorsum is dark green with reddish brown flecks and faint greenish cream canthal and dorsolateral stripes bordered below by reddish brown stripes. The belly is white, and other ventral surfaces are pale green; the axilla and groin are pale blue. The iris is pale silver.

Similar species: This is the smallest species of *Sphaenorhynchus* in the region. *Sphaenorhynchus lacteus* has more extensive webbing on hands and a dark canthal stripe but lacks dorsolateral stripes; *S. dorisae* has a rounded snout and white flecks on the dorsum and no dark face markings. The much larger *Hyla punctata* has red flecks and dorsolateral stripe, but it has a broad, rounded snout. *Eleutherodactylus acuminatus* also has a dark canthal stripe, but it has a pointed snout and lacks webbing between the fingers and toes.

Natural history: Little is known about the habits of this semiaquatic frog. At night, they are in permanent and semipermanent ponds in open areas. Males call, from emergent vegetation at water level in ponds, the call is a series of clicks produced at a rate of about 77 notes per minute. A female contained 143 eggs, 1 mm in diameter. Tadpoles are unknown.

***Sphaenorhynchus dorisae* (Goin) (Plate 7I)**

Identification: Males 26–29 mm; females 36–40 mm. The snout is rounded in dorsal view. The fingers are one-third and the toes, fully webbed; dermal flaps are present lateral to the cloacal opening and on the heels. The dorsum is lavender green with small, round white to yellow spots; the venter is white. The iris is bronze.

Similar species: The presence of small white spots on the back and a short, rounded snout, and the absence of a canthal stripe distinguish this frog from the other two *Sphaenorhynchus*, both of which have dark canthal stripes.

Natural history: At night, this semiaquatic frog is commonly found amidst floating vegetation, usually dominated by water lettuce (*Pistia*), in open permanent and semipermanent ponds. Males call from the floating vegetation throughout the year; the call is a series of 3–6 metallic notes. Clutches of 147–218 green eggs, 2.3 mm in diameter, are deposited in water; the eggs hatch in about eight days. The body and tail of the tadpoles are pale gold with red flecks on the tail.

***Sphaenorhynchus lacteus* (Daudin) (Plate 7J)**

Identification: Males 32–41 mm, females 39–46 mm. The snout is pointed

in dorsal view. The fingers are one-half and the toes four-fifths webbed; dermal flaps are present lateral to the cloacal opening but absent on the heels. The dorsum is uniform green with a dark brown canthal stripe; the belly and outer margins of the limbs are white, and the ventral surfaces of the limbs are bluish green. The iris is pale creamy bronze.

Similar species: *Sphaenorhynchus dorisae* also has dermal flaps, but it lacks a dark canthal stripe and has a rounded snout; *S. carneus* also has canthal stripes, but it is much smaller and has dorsolateral stripes. Other green frogs in the region lack webbing (*Eleutherodactylus acuminatus*), have finely granular dorsal skin (*Hyla granosa*) or have red and yellow dorsolateral stripes and red flecks on the dorsum (*Hyla punctata*).

Natural history: At night, this semiaquatic frog congregates at permanent or semipermanent ponds in open areas. Males call from floating vegetation or emergent grasses. The call is one short, loud, low-pitched note. Clutches of 252–394 pigmented eggs are deposited in water. Tadpoles are colorful; the body is black with gold spots laterally, and the tail has black spots on the musculature and black bars on the fins.

TERRESTRIAL FROGS (FAMILY LEPTODACTYLIDAE)

Leptodactylids are highly diversified in the Amazon Basin; they display great variation in size, shape, food, reproductive modes, and habits. Most are terrestrial, but some are arboreal, and one is aquatic.

Ceratophrys cornuta (Linnaeus) (Plate 1J)

Identification: Males 48–72 mm, females 79–118 mm. The body is robust, and the head is deep; its width is about one-half of the length of the head and body combined. The skin on the dorsum is smooth with scattered small tubercles; the upper eyelid bears an elongate process. The fingers and toes are long and lack discs; the fingers are unwebbed, and the toes about one-half webbed. The dorsum is green or tan with bold darker green or brown markings; the throat is dark brown, and the belly is white. The iris is creamy bronze with a median, horizontal dark streak.

Similar species: The only other frogs in the region having eyelid “horns” are the species of *Hemiphractus*, which have triangular heads, depressed bodies, and discs on the digits; *Bufo ceratophrys*, which has cranial crests, parotoid glands, and tuberculate skin on the dorsum; and the minute *Pseudopaludicola ceratophyes*, which is pale tan and has a prominent tubercle on the tarsus. Juveniles might be confused with *Eleutherodactylus sulcatus*, which lack eyelid processes and webbing on the feet.

Natural history: This terrestrial, nocturnal frog backs into leaf litter so that only the head is visible. In this position it waits for passing prey, which

includes frogs, lizards, small mammals, and a variety of insects. After the first heavy rains of the season, they congregate around forest ponds and swamps, where males call from shallow water. The call is a loud "baaaa." Clutches contain about 500 brown eggs, 2.3–2.5 mm in diameter, that hatch in 1 or 2 days. Tadpoles attain lengths of 47 mm. The body is globular; the eyes are dorsolateral and directed anterolaterally. The tail musculature is robust, and the tail terminates in a blunt tip; the dorsal fin is slightly higher than the ventral fin and barely extends onto the body. The oral disc is terminal and completely bordered by conical papillae. The jaw sheaths are massive and lack serrations, but a long, pointed process on the lower sheath inserts into a notch on the upper sheath; the LTRF is 13(6)/8(2). The body and tail musculature are tan; the belly is greenish yellow, and the tail fins are translucent tan. Tadpoles are voracious predators on other tadpoles.

ELEUTHERODACTYLINES

Frogs of the genus *Eleutherodactylus* and their allies are primarily terrestrial and nocturnal, but some species of *Eleutherodactylus* are arboreal. Most species are small (less than 50 mm). All species of *Eleutherodactylus* in the region, with the exception of *E. nigrovittatus* and *E. sulcatus*, have long digits with expanded terminal discs; the fingers lack webs, and most species have unwebbed toes. Males have single, median, subgular vocal sacs, and most have nuptial pads on the thumbs. These frogs have a highly specialized reproductive mode and do not congregate at ponds for breeding; instead, males call solitarily throughout the forest. Few, large, unpigmented eggs are deposited in damp places on the ground, amidst leaf litter, in rotting logs, or in bromeliads. There is no aquatic tadpole stage; instead, the eggs hatch as miniatures of the adults. Eleutherodactylines are primarily sit-and-wait predators on a variety of insects and spiders, but some feed almost exclusively on ants.

Adelophryne adiastrala Hoogmoed and Lescure (Plate 8I)

Identification: Males and females about 14 mm. The body is moderately robust, and the snout is rounded. The eyes are large, and a tympanum is present. The skin on the dorsum is roughened, and that on the belly is smooth. The hands are small with depressed fingers that terminate in asymmetrically pointed discs; the first finger is shorter than the second, and the fourth finger is very short. The toes are long and terminate in asymmetrical tips; webbing and nuptial pads are absent. The dorsum is uniform dark brown, and the venter is black with cream spots. The iris is red.

Similar species: Other tiny frogs having reduced digits on the hand include *Phyllonastes myrmecoides*, which differs by having each digit terminating in a papilla, a prominent tubercle on the ventral edge of the tarsus, and by

having large dark spots in the groin, and *Syncope*, which have only three fingers and four toes that terminate in small discs.

Natural history: Nothing is known about reproduction in this nocturnal inhabitant of leaf litter in primary forest.

Eleutherodactylus aaptus Lynch and Lescure

Identification: Males 23 mm, females 30–35 mm. The skin on the dorsum is roughened; that on the venter is venated. The snout is long and pointed, and the tympanum is distinct. The first finger is shorter than the second. The fingers and toes have lateral fringes and large, broadly elliptical terminal discs. Females have flared lips, and males have nuptial pads on the thumbs. The dorsum is grayish brown with a dark brown supratympanic stripe and two vertical bars on the lip. The groin, posterior surfaces of the thighs, and ventral surfaces of the shanks are black. The venter is creamy white with gray reticulations on the chest and belly.

Similar species: The absence of a pattern on the dorsum of the body and the presence of uniform black in the groin and on the posterior surfaces of the thighs and ventral surfaces of the shanks distinguishes *E. aaptus* from all other small frogs in the region, except *E. lythrodes*, which has a black and red venter.

Natural history: Nothing is known.

Eleutherodactylus acuminatus Shreve (Plate 9G)

Identification: Males 17–23 mm, females 26–34 mm. The skin on the dorsum is smooth to finely granular, and that on the venter is granular. The snout is short and pointed; a tympanum is not evident. Webbing is absent on the foot, and the digits terminate in broadly rounded discs. The dorsum is green, and the flanks and belly are creamy white. A black stripe extends from the snout through the eye to a point above the arm or to a point on the flank; labial bars are absent. The iris is pale bronze.

Similar species: The only other small green frogs in the region are *Hyla* and *Sphaenorhynchus*, all of which have extensive webbing between the toes. *Eleutherodactylus lacrimosus* also lacks labial bars, but it differs from *E. acuminatus* by having a tympanum.

Natural history: This inhabitant of forest usually is perched on leaves at night; by day they have been found in bromeliads and sleeping on the undersides of leaves on bushes and trees. The call is a short, high whistle, repeated infrequently. Clutches of 12–21 eggs, 2.4 mm in diameter, are laid in bromeliads. Ants make up most of the diet.

***Eleutherodactylus altamazonicus* Barbour and Dunn (Plate 9A)**

Identification: Males 18–24 mm, females 28–34 mm. The skin on the dorsum is tuberculate; that on the belly is granular. The snout is short and truncate, and the tympanum is not evident. The toes lack webbing, and the fingers and toes terminate in broadly expanded, truncate tips. The dorsum is tan to reddish brown with a highly variable pattern, often including a dark W-shaped mark in the scapular region; the lips and limbs are barred, and canthal and postorbital stripes are absent. The groin and posterior surfaces of thighs are barred or spotted with black and dull red; the venter is brown with minute white flecks. The iris is reddish copper with a grayish suffusion.

Similar species: This species is most easily confused with *Eleutherodactylus diadematus*, which differs by having a distinct tympanum, pale venter with dark mottling, rounded snout, and the groin bluish white or yellowish tan with diagonal dark bars. The species also resembles *E. ockendeni*, and *E. ventrimarmoratus*. The former has a distinct tympanum, a tubercle on the upper eyelid, a gray venter, and lacks red and black bars in the groin; the latter lacks a tympanum and has bold black and white mottling on the venter and hidden surfaces of the limbs.

Natural history: Individuals sometimes are found in leaf litter in primary forest by day, but usually they are perched on, and call from, low vegetation in the forest at night. The call is a soft cluck, repeated once or twice in succession. Females have 12–25 eggs, up to 2.5 mm in diameter.

***Eleutherodactylus carvalhoi* Lutz (Plate 9F)**

Identification: Males are 15–17 mm, females 17–24 mm. The skin on the dorsum is finely tuberculate; that on the belly is granular. The snout is moderately long and pointed; the tympanum is barely evident. The toes lack webbing; the first finger is longer than the second, and the digits terminate in broadly rounded discs. The dorsum is dull brown with or without a darker brown W-shaped mark in the scapular region or a middorsal cream stripe. The groin is bright yellow. Dark canthal and postorbital stripes are absent, and there is a pale bar below the eye. The venter is cream with many small brown flecks. The iris is pale bronze.

Similar species: The only other *Eleutherodactylus* in the region having a large yellow spot in the groin is *E. variabilis*, in which the yellow spots extend onto the proximal anterior parts of the thighs, are confluent, or nearly so, across the belly, and are narrowly bordered by black or dark brown. Furthermore, *E. variabilis* has a distinct tympanum and weakly granular skin on the dorsum.

Natural history: This frog is most frequently observed perched on low vegetation in primary forest at night. Nothing is known about its life history.

Eleutherodactylus conspicillatus (Günther) (Plate 10B)

Identification: Males 25–31 mm; females 35–49 mm. The skin on the dorsum is roughened with conspicuous dorsolateral folds; the venter is smooth. The snout is moderately long and narrowly rounded; the tympanum is distinct and slightly more than one half the diameter of the eye. The toes are webbed basally and have narrow lateral fringes; first finger longer than second, and the digits terminate in broadly elliptical discs. The dorsum is tan to reddish brown with dark brown chevrons on the back and narrow transverse bars on the limbs; the posterior surfaces of the thighs are dark brown with small red dots; and the side of the head is dark brown to black. The venter is white, and the iris is bronze with a median, horizontal red streak.

Similar species: Among the species of *Eleutherodactylus* in the region with smooth skin on the venter and expanded digital tips, *E. conspicillatus* is most like *E. peruvianus*, which differs by having a cream venter with dark spots on the throat and chest and pale spots on the ventral surfaces of the thighs. The other species (*E. lanthanites*, *malkini*, and *vilarisi*) lack dorsolateral folds and red spots on the posterior surfaces of the thighs.

Natural history: Although occasionally observed on the forest floor by day, this species is most commonly found on low vegetation at night. The call consists of a series of low-pitched soft notes. Gravid females can contain 27–62 unpigmented eggs up to 3.5 mm in diameter.

Eleutherodactylus diadematus (Jiménez de la Espada) (Plate 9J)

Identification: Males 21–28 mm, females 35–46 mm. The skin on the dorsum is smooth with scattered tubercles; the venter is granular. The snout is rounded, and the tympanum is present. The toes lack webbing but have narrow lateral fringes; the first finger is shorter than the second, and the digits terminate in broad, truncate discs. The dorsum is tan, gray, or reddish brown with dark brown longitudinal marks extending from the eyelids to the scapular region and usually an irregular transverse mark in the scapular region. The groin and proximal anterior and dorsal surfaces of the thighs are bluish white to yellowish tan with diagonal dark brown bars in the groin and transverse bars on the limbs. The posterior surfaces of the thighs are dark brown. Canthal and postorbital stripes are absent, but dark brown bars are present on the lips. The venter is creamy white with brown dashes or mottling. The iris is greenish bronze below and dark red above.

Similar species: *Eleutherodactylus altamazonicus* also has diagonal dark marks on the flanks, but it differs from *E. diadematus* by having a truncate snout, tubercular dorsum, dark venter, and no evident tympanum. The species also resembles *E. ockendeni*, and *E. ventrimarmoratus*. The former has a tubercle on the upper eyelid, a gray venter, and lacks the markings in the

groin; the latter lacks a tympanum and has bold black and white mottling on the venter and hidden surfaces of the limbs. Some individuals of *E. diadematus* have orange flecks on the posterior surfaces of the thighs; other *Eleutherodactylus* in the region having flecks on the thighs have smooth skin on the venter.

Natural history: This arboreal species is nocturnal in upland forest. A clutch of eggs deposited in the laboratory contained 18 unpigmented eggs 3.9 mm in diameter.

***Eleutherodactylus lacrimosus* (Jiménez de la Espada) (Plate 9E)**

Identification: Males 16–20 mm, females 20–24 mm. The skin on the dorsum is smooth; that on the venter is granular. The snout is round, and the top of the head is flat; a tympanum is present. The first finger is shorter than the second; the toes are unwebbed and bear narrow lateral fringes, and the digits terminate in large, rounded discs. The dorsum is yellow, tan, olive green, or reddish brown, usually with dark brown markings consisting of an interorbital bar and one or more marks on the body. The flanks and limbs are tan, and the venter is creamy yellow. Labial bars are absent. The iris is bronze with a median, horizontal red streak.

Similar species: This small species with a flat head, proportionately large eyes, and round discs on the digits can be confused with small species of *Hyla*, all of which differ by having webbing between the toes. *Eleutherodactylus acuminatus*, which has a green dorsum, also lacks labial bars, but it differs from *E. lacrimosus* by lacking a tympanum.

Natural history: This small inhabitant of primary forest is active on leaves of bushes at night. The call is a single peep repeated at intervals of a minute or more. A pair deposited seven unpigmented eggs having diameters of 4.5 mm.

***Eleutherodactylus lathanites* Lynch (Plate 10A)**

Identification: Males 22–26 mm, females 28–42 mm. The skin on the dorsum is finely tubercular with scattered larger tubercles; the venter is smooth. The snout is moderately long and pointed; the tympanum is distinct and about one half the diameter of the eye. The toes lack webbing and lateral fringes; the first finger is longer than the second, and the digits terminate in broadly elliptical discs. A prominent, conical tubercle is present on each heel. The dorsum is various shades of tan with dark brown chevrons on the back and broad transverse bars on the limbs; the posterior surfaces of the thighs are uniform brown or have faint yellowish orange spots, and the lips are faintly barred with brown. The throat is white, heavily suffused with gray, with a median, longitudinal white streak; the rest of the venter is creamy

white with gray flecks. The iris is bronze with a median, horizontal red streak and radiating black lines ventrally.

Similar species: *Eleutherodactylus lanthanites* differs from all other *Eleutherodactylus* in the region with smooth skin on the belly and expanded digital tips by having a conical tubercle on the heel and a median, longitudinal white stripe on a gray throat.

Natural history: Equally abundant in primary and secondary forest, this frog is active on the ground by day and on low vegetation at night. Gravid females contain 20–52 unpigmented eggs up to 3.2 mm in diameter.

Eleutherodactylus lythrodes Lynch and Lescure (Plate 9H)

Identification: Males 16–18 mm, females 24–26 mm. The skin on the dorsum is roughened; the venter is venated; the snout is moderately long and truncate, and the distinct tympanum is about one third the size of the eye. The toes lack webbing, but narrow lateral keels are present on the fingers and toes; the first finger is shorter than the second, and the tips of the digits are expanded into broadly elliptical discs. The dorsum is brownish black with no markings other than a few gray spots on the side of the head; the venter is black with white spots on the throat and large red blotches on the limbs and belly, extending into the groin.

Similar species: This small black frog with bright red blotches on the venter cannot be confused with any other species in the region.

Natural history: Practically nothing is known about this inhabitant of primary forest.

Eleutherodactylus malkini Lynch (Plate 10D)

Identification: Males 28–37 mm, females 42–49 mm. The skin on the dorsum is roughened with scattered tubercles; the venter is smooth. The snout is long and pointed; the tympanum is distinct and about one third of the diameter of the eye. The toes have basal webbing and lateral fringes; the first finger is longer than the second, and the digits terminate in broadly elliptical discs. The dorsum is orange-tan with small dark brown spots on the back and narrow transverse bars on the limbs; the posterior surfaces of the thighs are black with greenish gold flecks, and the side of the head and labial bars are brown. The throat is white, and the rest of the venter is pale yellow. The iris is bronze with a median, horizontal brown streak.

Similar species: Among the species of *Eleutherodactylus* in the region with smooth skin on the venter and expanded digital tips, *E. malkini* is most like *E. lanthanites*, which differs by having a conical tubercle on the heel and a gray throat with a median white streak; *E. malkini* also resembles *E. vilarsi*,

which differs by having a gray venter and no pale spots or flecks on the posterior surfaces of the thighs.

Natural history: This species occurs in primary forest, where it is most commonly seen on the ground, logs, or tree roots along small streams at night.

Eleutherodactylus martiae Lynch (Plate 9B)

Identification: Males 13–17 mm, females 18–23 mm. Skin on dorsum covered with low, flat tubercles; the belly is granular. The snout is short and rounded, and the tympanum is absent. The toes are unwebbed, but the fingers and toes have narrow lateral fringes; the first finger is shorter than the second, and the digits terminate in rounded discs. The dorsum usually is brown with darker brown marks—interorbital bar, chevrons on back, labial bars, and transverse bars on limbs; some individuals have dark brown flanks outlining a uniform pale tan or reddish brown dorsum. The hidden surfaces of the limbs are brown, and the venter is pale gray or pale brown with or without white flecks. The iris is pale bronze with a median, horizontal reddish brown streak.

Similar species: The absence of a tympanum is shared with *Eleutherodactylus ventrimarmoratus*, which has bold black and white mottling on the flanks, belly, and hidden surfaces of the hind limbs. *Eleutherodactylus ockendeni* has a tubercle on the upper eyelid, and *E. altamazonicus* has red and black barred or spotted thighs.

Natural history: An inhabitant of primary and secondary forest, this small frog is most commonly observed on low vegetation at night. The call is a series of short clicks. Of four clutches containing 8–10 eggs, 3.2–3.7 mm in diameter, two eggs hatched in 26 days.

Eleutherodactylus nigrovittatus Andersson (Plate 10F)

Identification: Males 17–19 mm, females 19–22 mm. The skin on the dorsum and venter is smooth; the snout is broadly rounded, and the tympanum is distinct. The digits are short and lack webbing and expanded terminal discs; the first finger is slightly longer than the second, and males lack nuptial pads on the thumbs. The dorsum is tan to reddish brown with dark brown transverse bars on the limbs, dashes dorsolaterally on the body, and bars on the upper lips. The flanks and forelimbs are orange-tan; there is a large dark brown spot in the groin and below the cloacal opening. The posterior surfaces of the thighs are tan, and the venter is gray with minute white spots. The iris is dull bronze suffused with black.

Similar species: The species of *Adenomera* differ by having pustular skin on the dorsum, pointed snout, and longer fingers with small expanded discs;

also they have a dark triangular mark on the head and lack the brown spots in the groin and below the cloacal opening. *Adelophryne adiastrata* and *Phyllonastes myrmecoides* also have short fingers, which terminate in asymmetrically pointed tips in the former and small papillae in the latter. Furthermore, both species have dark venters with pale spots. *Eleutherodactylus sulcatus* is much larger, has a broad head, and an H-shaped dermal fold on the dorsum. Other *Eleutherodactylus* in the region with smooth skin on the venter have broadly expanded tips to the fingers and toes.

Natural history: This small species is active by day amidst leaf litter in terra firme forest. Gravid females contain nine or ten eggs about 2.5 mm in diameter.

Eleutherodactylus ockendeni (Boulenger) (Plate 9C)

Identification: Males 18–21 mm, females 25–31 mm. The dorsum is roughened with or without tubercular dorsolateral folds or W- or H-shaped mark in the scapular region; there is a conical tubercle on the eyelid, and the belly is granular. The snout is rounded, and the tympanum is about one third the size of the eye. The toes lack webbing, but narrow lateral keels are present on the fingers and toes; the first finger is shorter than the second, and the digits terminate in rounded discs. The dorsum is pale tan to reddish brown with darker brown markings—two transverse marks on posterior part of body, W- or H-shaped marks corresponding to tubercles on back (if present), transverse bars on limbs and faint labial bars. The flanks are paler than the dorsum and marked or not by irregular brown spots. The hidden surfaces of the hind limbs are brown to rose-red, and the venter is pale gray. The iris is metallic green or bronze above a median, horizontal red streak, or the lower part is red.

Similar species: Other species of *Eleutherodactylus* of similar size and coloration in the region lack a tubercle on the eyelid.

Natural history: Males of this arboreal frog start calling at dusk from vegetation 2 m above the ground in primary forest; it is rarely observed in the lower forest strata. The call consists of two notes, “aah-aah.” Females contain up to 26 eggs 3.5 mm in diameter.

Eleutherodactylus peruvianus (Melin) (Plate 10C)

Identification: Males 29–36 mm, females 38–46 mm. The skin on the dorsum is smooth with dorsolateral folds and scattered small tubercles; the venter is smooth. The snout is moderately long and narrowly rounded. The toes are unwebbed but have narrow lateral keels; the first finger is longer than the second, and the digits terminate in broadly elliptical discs. The dorsum is reddish tan to brown, usually with distinct darker chevrons, transverse bars on the limbs, and labial bars; the posterior surfaces of the thighs are dark

brown with small red or yellow spots. The venter is cream with brown spots on the throat and chest; the ventral surfaces of the limbs are pale gray with cream spots on the shanks. The iris is reddish copper.

Similar species: Among the species of *Eleutherodactylus* in the region with smooth skin on the venter and expanded digital tips, *E. peruvianus* is most like *E. conspicillatus*, which differs by having a uniformly white venter. The other species (*E. lanthanites*, *malkini*, and *vilarsi*) lack dorsolateral folds and red spots on the posterior surfaces of the thighs.

Natural history: This species is most common on the ground in primary forest, where it is active by day and night; some individuals ascend low herbs and bushes at night.

Eleutherodactylus sulcatus (Cope) (Plate 9I)

Identification: Males 29–35 mm; females 42–54 mm. The skin on the dorsum is smooth with scattered tubercles and short, longitudinal ridges tending to form an H-shaped pattern in the scapular region; tubercles are present on the upper eyelids, and the belly is granular. The head is depressed and broad (equal to about one half the length of the head and body) and has a pair of longitudinal ridges between the eyes; the snout is bluntly rounded, and a distinct tympanum is present. The toes are unwebbed; the first finger is longer than the second, and the fingers and toes lack lateral fringes and expanded tips of the digits. The dorsum is dull gray to reddish tan with or without dark brown marks on the body. Narrow transverse brown marks are present on the limbs, and the upper lips are boldly barred with brown. The groin and hidden surfaces of the hind limbs are dark brown to black with large cream spots. The venter is grayish cream, and the ventral surfaces of the hands and feet are dull orange. The iris is silver with black reticulations.

Similar species: The only other frogs in the region with broad heads and unexpanded tips on the fingers and toes are *Ceratophrys cornuta*, which has a deep head and fleshy eyelid projections, and *Ischnocnema quixensis*, which has a tan dorsum and large tubercles on all dorsal surfaces.

Natural history: Little is known about this terrestrial frog, which usually is found in upland forest at night. Females contain up to 32 eggs, 2.5 mm in diameter.

Eleutherodactylus variabilis Lynch (Plate 10G–H)

Identification: Males 16–19 mm, females 22–27 mm. The skin on the dorsum is roughened, and the belly is granular; the snout is moderately long and narrowly rounded. The tympanum is distinct. The toes have basal webbing and lateral fringes; the first finger is slightly shorter than the second, and the digits have broad, truncate discs. The dorsal coloration varies from brown to

red or green with or without darker transverse or diagonal markings on the body and limbs. A large yellow spot, usually narrowly bordered by black is present in the groin and on the proximal anterior surfaces of the thighs; these spots are confluent, or nearly so, midventrally. The posterior surfaces of the thighs are dull red, rose-pink, or gray; the venter is cream with brown flecks. The iris is bronze with a median, horizontal brown streak.

Similar species: The only other *Eleutherodactylus* in the region having a large yellow spot in the groin is *E. carvalhoi*, in which the yellow spots do not extend onto the thigh and belly and are not bordered by black. Furthermore, *E. carvalhoi* has an indistinct tympanum and tubercular skin on the dorsum.

Natural history: This small frog is found in disturbed areas and in primary forest sitting in bushes at night. The call is a series of soft clicks. Clutches of 5–11 eggs about 4 mm in diameter presumably are deposited amidst the forest leaf-litter; small froglets hatch about 4 weeks latter.

Eleutherodactylus ventrimarmoratus (Boulenger) (Plate 9D)

Identification: Males 18–26 mm, females 33–44 mm. The skin on the dorsum, flanks, and limbs is tuberculate; the belly is venated; the snout is rounded, and a tympanum is absent. The toes are unwebbed, but the fingers and toes have narrow lateral fringes; the first finger is shorter than the second, and the digits terminate in broadly elliptical discs. Males lack nuptial pads on the thumbs. The dorsum is brown with faint black markings edged with white flecks. The flanks, hidden surfaces of hind limbs, and belly are white with bold black mottling. The throat and ventral surfaces of the limbs are red. The iris is pale gold.

Similar species: *Eleutherodactylus altamazonicus* also lacks a tympanum; however it is smaller, has a brown venter, and the groin and posterior surfaces of the thighs are black and dull red.

Natural history: This inhabitant of primary forest usually is observed perched on leaves of trees and bushes at night. The call is a soft “click.”

Eleutherodactylus vilarsi (Melin) (Plate 10E)

Identification: Males 25–32 mm, females 34–43 mm. The skin on the dorsum is roughened; the venter is smooth; the snout is long and narrowly rounded, and the tympanum is distinct and about one half the diameter of the eye. The toes lack webbing and lateral fringes; the first finger is longer than the second, and the digits terminate in broadly elliptical discs. The dorsum is tan with brown chevrons on the back and narrow transverse bars on the limbs; the posterior surfaces of the thighs are uniform brown, and the venter is gray.

Similar species: *Eleutherodactylus vilarsi* is like *E. lanthanites* and *E. malkini* in having the first finger longer than the second, smooth skin on the belly, and in lacking dorsolateral folds. It differs from both species by having a gray venter. Furthermore, it differs from *E. lanthanites* by lacking a white streak on the throat and conical tubercle on the heel, and from *E. malkini* by lacking pale flecks on the posterior surfaces of the thighs.

Natural history: Little information exists about this species that is mostly terrestrial and nocturnal in primary and secondary forest.

Ischnocnema quixensis (Jiménez de la Espada) (Plate 11)

Identification: Males 37–48 mm, females 41–59 mm. All dorsal surfaces are covered with large and small tubercles; the venter is smooth. The snout is rounded, and the tympanum is distinct. The fingers and toes are long, lack webbing and lateral fringes, and terminate in knoblike tips. The tubercles under the fingers and toes are large and conical. The dorsum is pinkish tan to olive brown with dark brown markings—irregular marks on back, broad transverse bars on the limbs, and vertical bars on the upper lip. The flanks and the hidden surfaces of the thighs are pale brown, and the venter is grayish brown with white mottling. The iris is coppery bronze.

Similar species: This toadlike species differs from toads of the genus *Bufo* by having tubercles on the head and by lacking cranial crests and parotoid glands. *Eleutherodactylus sulcatus* also has knoblike tips to the digits, but it has longitudinal ridges on an otherwise relatively smooth dorsum, and the posterior surfaces of the thighs black with large cream spots.

Natural history: This terrestrial inhabitant of primary and secondary forest is active at night. The call consists of a series of low-pitched guttural notes. Gravid females contain 15–51 eggs up to 4.1 mm in diameter.

Phyllonastes myrmecoides (Lynch) (Plate 8J)

Identification: Males 11–13 mm, females 12–14 mm. The skin on the dorsum is roughened with small tubercles on the flanks; the venter is smooth. The snout is truncate, and the tympanum is distinct. The digits lack webbing and lateral folds and terminate in small papillae; the first finger is shorter than the second, and there is a prominent tubercle on the middle of the tarsus. The dorsum is reddish tan with dark brown chevrons connected along midline; a middorsal cream stripe may be present. The side of the head and flanks are black; the venter is gray with white spots. The iris is bronze with black flecks.

Similar species: This species is most easily confused with *Adelophryne adiastrata*, which lacks the tarsal tubercle and possesses digits that terminate in depressed, asymmetrical points. *Phyllonastes* also resembles *Pseudo-*

paludicola ceratophyes, which has a conical tubercle on the eyelid; *Syncope*, which has only three fingers and four toes; juveniles of *Hamptophryne boliviana*, which have rounded tips to the digits and a dark middorsal blotch. All of these lack tarsal tubercles.

Natural history: This small frog is active by day amidst damp leaf litter in primary forest, where it feeds on ants.

LEPTODACTYLINES

Frogs of the genus *Leptodactylus* and its allies are primarily terrestrial; *Hydrolaetare schmidtii* is aquatic, and none is arboreal. All have smooth skin on the venter. The fingers lack webbing, and the toes are no more than basally webbed, except in *Hydrolaetare schmidtii*, in which they are fully webbed. For all of the species for which the life history is known, the eggs are deposited in a foam nest, which is formed by the pair kicking their feet into a mixture of water, spawn, and sperm, all mixed with air to resemble the meringue of a pie. Furthermore, except for *Adenomera*, in all species for which the larvae are known, the tadpoles develop in ponds and have ovoid bodies with rounded snouts, tails that terminate in an acutely rounded tip, anteroventral oral discs with a bare median portion of the upper lip and the rest of the disc bordered by one or two rows of papillae, and a LTRF of 2/3.

Adenomera andreae (Müller) and *Adenomera hylaedactyla* (Cope) (Plate 8H)

Identification: These two species are essentially indistinguishable morphologically. Males 18–24 mm, females 23–28 mm. The dorsum has several longitudinal rows of low tubercles. The snout is moderately long and pointed, and the tympanum is distinct. The first and second fingers are equal in length, and the toes lack webbing and lateral fringes; all digits end in small, round discs that tend to be flattened in section in *A. andreae* and rounded in *A. hylaedactyla*. The dorsum varies from dull gray to tan with brown spots, with or without cream to pink dorsolateral stripes or a cream middorsal stripe posteriorly on the body; a dark brown triangular mark is present on the back of the head. In many individuals the forelimbs are creamy orange; the venter is creamy white. The iris is bronze with minute black flecks.

Similar species: Both species are similar to two larger species—*Leptodactylus wagneri* and *Vanzolinius discodactylus*, both of which have the first finger longer than the second and lateral fringes on the toes. *Eleutherodactylus nigrovittatus* is about the same size, but the skin on the dorsum is smooth, the snout is short and blunt, and a black cloacal patch is present, whereas a triangular mark on the head is absent.

Natural history: The two terrestrial species differ in habitat and call. *Adenomera andreae* inhabits primary forest, where it is active by day and

night; the call is a single, long, harsh long note, similar to the cry of a kitten. *Adenomera hylaedactyla* usually is active in open areas at night; the call is a high-pitched note. Both species excavate flask-shaped cavities, in which females deposit fewer than 20 unpigmented eggs about 3 mm in diameter in a foam nest. The tadpoles develop in the nest; they subsist entirely off of the yolk provided in the eggs and emerge from the nest as miniature replicas of the adults.

***Edalorhina perezii* Jiménez de la Espada (Plate 2B)**

Identification: Males 28–36 mm, females 35–40 mm. The skin on the dorsum is tuberculate or has longitudinal ridges; small conical tubercles are present on the eyelids. The venter is smooth. The body is depressed, and the snout is pointed. The fingers and toes are unwebbed, and the first and second fingers are equal in length. The dorsum is brown with irregular dark brown markings on the back and transverse bars on the limbs; the groin is orange with a black spot. The venter is white with large lateral and posterior black blotches. The iris is bronze with radiating gray-brown bars.

Similar species: *Physalaemus petersi* also has orange in the groin, but differs by having black and white mottling on the belly, a gray throat and chest, and no conical tubercles on the eyelids. Toads (*Bufo*) have granular skin on the belly and parotoid glands.

Natural history: Diurnal and terrestrial, this species inhabits primary and secondary forest, especially in areas with an accumulation of leaf litter. Males call from the edges of water-filled depressions in the ground, leaf litter, and logs. The call consists of a series (usually 3–5) short-low whistles. Amplectant pairs construct hemispherical foam nests 60–75 mm in diameter that float on the water in small, ephemeral ponds or water-filled cavities in logs. The nests contain 30–154 small, unpigmented eggs, 2.1 mm in diameter, that hatch in 3–5 days. Tadpoles attain lengths of 28 mm, of which about 63% is tail. The body is pale tan with darker brown mottling dorsally and laterally; the tail is translucent.

***Hydrolaetare schmidtii* (Cochran and Goin) (Plate 10J)**

Identification: Males 80–104 mm, female 115 mm. The body and limbs are robust; the head is broad and depressed. The eyes are large and dorsolateral with vertically elliptical pupils. The tympanum is one half the size of the eye. The skin is smooth except for low tubercles on the flanks. The first finger is much longer than the second, and the second and third fingers have broad lateral fringes. The toes are long, pointed, and fully webbed. Males lack nuptial pads on the thumbs. The dorsum is dull olive green with dark brown markings—large blotch on back, canthal stripe, bars on the lips, and transverse marks on the limbs. The venter is creamy yellow with bold dark

brown reticulations or spots. The iris is silvery gray with fine black lines and horizontal brown bar.

Similar species: *Rana palmipes* is about the same size and also has pointed digits and fully webbed feet, but it has a dorsolateral dermal fold, a tympanum that is nearly as large as the eye, and a creamy white venter with gray suffusion. Other large frogs with fully webbed feet in the region are treefrogs with toes terminating in large discs.

Natural history: Little is known about this nocturnal, aquatic frog that is observed in water at the edges of lakes and slow-moving rivers. Males call from flooded underground tunnels near water, and the call consists a series of low groans. The tadpoles are unknown.

***Leptodactylus bolivianus* Boulenger (Plate 11A)**

Identification: Males 72–103 mm, females 73–88 mm. The body is robust with an elongated snout. The skin on the dorsum is smooth with two dorso-lateral folds extending from behind the eyes to the groin. The first finger is longer than the second, and the toes have lateral fringes and basal webbing. Breeding males have greatly swollen forearms and a single, large, blunt, flattened spine on the thumb. The dorsum is pale brown, usually with darker brown spots; the venter is immaculate cream with tan mottling on the throat. The posterior surfaces of the thighs are mottled dark brown and cream. The iris is bronze with black flecks.

Similar species: *Leptodactylus bolivianus* differs from other large members of the genus (*L. knudseni*, *pentadactylus*, *rhodomystax*, *rhodonotus*, and *stenodema*) by having lateral fringes and basal webbing on toes and an elongated snout, which is shorter and rounded in the other species. Furthermore, they all have darker ventral coloration and shorter limbs. *Leptodactylus mystaceus* is similar in shape and ventral coloration, but it is much smaller (maximum length 60 mm) and has a broad white stripe along the upper lip and a cream stripe on the posterior surface of the thigh.

Natural history: This nocturnal, terrestrial frog is most common in disturbed forests and clearings. The call is a single low-pitched “whop.” The foam nests containing numerous eggs are constructed in shallow water. Tadpoles attain lengths of about 50 mm, of which about 60% is tail. The body and tail are brown with small cream flecks on the tail. This female remains close to the foam nest and remains with the tadpoles after they hatch and move about in a school.

***Leptodactylus knudseni* Heyer (Plate 11C–D)**

Identification: Males 97–165 mm, females 136–148 mm. The body and limbs are robust, and the snout is short. The skin on the dorsum is smooth

with a pair of dorsolateral dermal folds extending posteriorly to the sacrum. The fingers and toes lack webbing and fringes, and breeding males have swollen forearms and a single, horny spine on the thumb. The dorsum is tan or pale green with large, darker bordered, brown or dark green transverse blotches; triangular dark marks are present on the upper lip. The venter is grayish brown, usually with cream flecks, and the posterior surfaces of the thighs are black. The iris is dark bronze.

Similar species: *Leptodactylus knudseni* is most easily confused with *L. pentadactylus*, which has dorsolateral folds extending to the groin, supratympanic folds that continue onto the sides of the body, and usually a reddish brown dorsum and low, dark labial bars, instead of triangles.

Natural history: This nocturnal, terrestrial frog inhabits upland forest, where pairs construct foam nests in depressions next to shallow pools. The call consists of a low-pitched, frequency-modulated, pulsed note about 0.3 sec long, "who-ep." The first pulse is lower pitched than the second one. Tadpoles attain a total length of 69 mm while still in the foam nest; subsequently they move into swamps to complete their development. Tadpoles have been observed eating frog eggs, even those in their own clutch.

Leptodactylus mystaceus (Spix) (Plate 11B)

Identification: Males 40–56 mm, females 52–60 mm. The body is robust, and the snout is pointed. The skin on the dorsum is smooth, and there is a pair of prominent dorsolateral dermal folds. The fingers and toes lack webbing and fringes, and breeding males lack spines on the thumbs. The dorsum is gray or tan with darker gray or brown chevrons on the back and bars on the hind limbs. There is a dark brown or black face mask, bordered below by a wide white labial stripe. The venter is white, and the posterior surfaces of the thighs are mottled brown and black with a cream longitudinal stripe distally. The iris is bronze above and metallic reddish brown below.

Similar species: The combination of the dark face mask, white labial stripe, and the longitudinal cream stripe on the posterior surfaces of the thigh serve to distinguish this frog from any other *Leptodactylus* in the region. Among these, only *L. rhodomystax* has a labial stripe, but the stripe is pinkish tan; also this species has a blunt snout and dark venter.

Natural history: This nocturnal, terrestrial species inhabits clearings, as well as primary and secondary forest. After heavy rains, males call from the vicinity of small pools; frequently they call from under logs and tree roots or from holes in the ground. The call consists of a series of short notes, "oit-oit-oit" at a rate of about 48 notes per min. Clutches of about 240 eggs, 2.4 mm in diameter, are deposited in foam nests floating on shallow water or on land adjacent to water. Tadpoles attain lengths of about 30 mm, of which about

65% is tail. The body is olive tan, and the belly is gray with gold flecks anteriorly; the tail is olive tan with dull green and yellow flecks and dark brown reticulations.

***Leptodactylus pentadactylus* (Laurenti) (Plate 11H)**

Identification: Males 140-169 mm, females 125-181 mm. This large, robust frog has a broad head, rounded snout, dorsolateral folds extending to the groin, and supratympanic folds that continue downward onto the sides of the body. The fingers and toes lack lateral fringes, and the toes are webbed basally. Breeding males have greatly swollen forearms, one large, black spine on each thumb, and a pair of horny spines on the chest. The dorsum is orange-tan or grayish tan with five or six broad, transverse brown blotches between the dorsolateral folds and transverse bars on the limbs. The upper lip is tan with short, black bars at the margin. The flanks are paler than the dorsum and have numerous black spots, and the posterior surfaces of the thighs are black with cream flecks. The venter is cream to gray, usually with bold black mottling on the belly and hind limbs. The iris is dark bronze.

Similar species: *Leptodactylus pentadactylus* is most easily confused with *L. knudseni*, which has dorsolateral folds extending only to the sacrum, supratympanic folds that do not continue onto the sides of the body, and a tan or pale green dorsum and dark triangles on the upper lip.

Natural history: A nocturnal, terrestrial inhabitant of primary forest, *Leptodactylus pentadactylus* has a distinctive call, a loud "woooooo," that is produced sporadically by males calling from holes in the ground. Large foam nests are constructed in burrows in the forest floor, sometimes isolated from forest pools or swamps; egg clutches contain nearly 1000 eggs about 3 mm in diameter. Tadpoles attain lengths of 62 mm, of which about 70% is tail. The body is grayish brown with a brown interorbital bar; the tail is brown with a creamy orange tint on the edge of the dorsal fin. Adults prey on a variety of arthropods, as well as other frogs. These large frogs are eaten by some Amazonian peoples.

***Leptodactylus rhodomystax* Boulenger (Plate 11E-F)**

Identification: Males 77-90 mm, females 70-83 mm. This large, robust frog has a broad head and rounded snout. The skin on the dorsum is smooth; dorsolateral folds extend to the groin. The fingers lack webbing and lateral fringes, and the toes are webbed basally. Males have a nuptial spine on each thumb and a pair of spines on the chest. The dorsum is reddish or grayish brown; the dorsolateral folds are dark brown, and the flanks are orange tan. The side of the head is dark brown, and the broad labial stripe is pinkish tan. The groin and posterior surfaces of the thighs are dark grayish brown with small greenish yellow spots. The throat is dark brown, and the other ventral

surfaces are cream heavily suffused with brown. The iris is dull bronze above and reddish bronze below.

Similar species: All other large *Leptodactylus* in the region lack a pale labial stripe, except the smaller (maximum length 60 mm) *L. mystaceus*, in which the labial stripe and venter are white, and the snout is pointed.

Natural history: This nocturnal, terrestrial species occurs in primary forest. Foam nests containing about 250 eggs, 3 mm in diameter, are constructed in natural depressions in the forest floor. The call and tadpoles are unknown.

Leptodactylus rhodonotus (Günther) (Plate 11I)

Identification: Males 54–79 mm, females 67–90 mm. The body and limbs are robust, and the snout is rounded. The skin on the dorsum is smooth with scattered tubercles, which are most numerous on the limbs and posterior part of the body, and prominent dorsolateral folds extending at least to the sacrum. The fingers and toes lack webbing and fringes. Breeding males have two horny nuptial spines on each thumb and a pair of spines on the chest. The dorsum is brown with darker brown dorsolateral stripes and transverse bars on the limbs, and usually with darker brown spots or interconnected marks on the back; the posterior surfaces of the thighs are cream with black spots or mottling, and the venter is creamy gray with diffuse cream spots. The iris is reddish bronze with black reticulations.

Similar species: Other large *Leptodactylus* in the region that are similar to *L. rhodonotus* include *L. rhodomystax* and *L. stenodema*, both of which lack tubercles on the dorsum. The former has a broad, pale labial stripe, and the latter lacks dark markings on the back.

Natural history: Terrestrial and nocturnal, this frog inhabits primary forest, where adults commonly sit at the entrances to burrows or at the edge of logs, under which they seek shelter. The call and reproductive behavior are unknown. Tadpoles attain lengths of 59 mm, of which 65% is tail.

Leptodactylus stenodema Jiménez de la Espada (Plate 11G)

Identification: Males 83–100 mm, females 82–100 mm. The body and limbs are robust; the head is large with a rounded snout. The skin on the dorsum is smooth; prominent dorsolateral dermal folds are continuous with the supratympanic folds. The fingers and toes lack webbing and lateral fringes; breeding males have a horny nuptial spine on the thumb. The dorsum is dull reddish brown with black dorsolateral folds and indistinct, narrow black transverse lines on the limbs. The posterior surfaces of the thighs are black. The side of the head is brown, and the upper lip is orange-brown with triangular black marks. The throat is dark brown, and the other ventral surfaces are grayish tan. The iris is bronze with a median horizontal red streak.

Similar species: All other large *Leptodactylus* in the region have dark markings on the dorsum of the body, except some individuals of *L. rhodonotus*, which has tuberculate skin on the posterior part of the body and limbs.

Natural history: Usually these frogs are seen sitting at the entrances of burrows in the ground in primary forest at night. The call is a low-pitched "whoop.". The tadpole is unknown.

Leptodactylus wagneri (Peters) (Plate 11J)

Recently it has been shown that the name *Leptodactylus wagneri* has been applied to a complex of several species, four of which (*L. diedrus*, *leptodactyloides*, *petersii*, and *wagneri*) occur in the Iquitos region; the species exhibit differences in size, distinctness of the longitudinal folds on the dorsum, and subtleties of color pattern, but differences in habitat and life history have yet to be determined. Thus, these species are treated together in this account.

Identification: Males 41–59 mm, females 51–77 mm. The body is robust, and the snout is rounded. The skin on the dorsum has many small spicules and short elongate ridges laterally. The fingers and toes lack webbing and terminate in narrow tips; the first finger is longer than the second, and the toes bear lateral fringes. Breeding males have two nuptial spines on each thumb. The dorsum and flanks are dull olive green to brown or gray with dark brown to black irregular spots or mottling. The upper lips and limbs are barred with dark brown, and usually there is a dark triangular mark on the back of the head. The posterior surfaces of the thighs are black with pale spots. The venter is dull creamy white with brown or dark gray mottling. The iris is dull bronze with a median horizontal grayish brown streak.

Similar species: The first finger longer than the second and lateral fringes on the toes distinguish this frog from the smaller *Adenomera*. *Vanzolinius discodactylus* is smaller and has small, expanded discs on the digits and a dark throat. Other species of *Leptodactylus* have dorsolateral folds and all but *L. bolivianus* lack fringes on the toes.

Natural history: This terrestrial frog is common in clearings and secondary forests. Adults usually are nocturnal, but juveniles also are active by day, especially after rains. Males call from shallow swamps. The call is a series of notes, "whoop-whoop-whoop." Foam nests containing 1726–1740 eggs, 1.0–1.5 mm in diameter, are deposited on the surfaces of swamps and ponds. Tadpoles attain lengths of 35 mm. The body is ovoid with a rounded snout and moderately large eyes directed dorsolaterally. The dorsal and ventral tail fins are about equal in height, and the tail terminates in an acutely rounded tip. The oral disc is anteroventral and has lateral folds; except for the median part of the upper lip, the disc is bordered by one row of papillae laterally and two rows ventrally. The jaw sheaths are slender and weakly serrated; the

LTRF is $2(1)/3$. The body is dark brown with white flecks laterally; the tail is cream with brown flecks.

***Lithodytes lineatus* (Schneider) (Plate 2J)**

Identification: Males 33–45 mm, females 44–56 mm. The body is moderately elongate, and the snout is bluntly rounded; the eyes are large and lateral, and the tympanum is about three fourths the size of the eye. The skin on the dorsum is finely spiculate, and that on the venter is smooth. The first finger is longer than the second, and the digits lack webbing and fringes. Males have nuptial pads on the thumbs. The dorsum is black with broad tan or pale yellow dorsolateral stripes; the limbs are tan with brown transverse bars. The venter is grayish brown with cream flecks, and large red spots are present in the groin and on the thighs. The iris is deep bronze with brown bars.

Similar species: Juveniles of *Lithodytes* might be confused with *Epipedobates femoralis*, which has narrow, white dorsolateral stripes, white labial stripes, a cream belly with brown spots, and no red spots on the thighs.

Natural history: This terrestrial frog inhabits primary forest, where adults often are associated with large nests of leaf-cutting ants. Males call from subterranean tunnels in these nests. Foam nests are constructed by amplexant pairs and contain unpigmented eggs. Tadpoles develop in ponds and attain lengths of 55 mm, two thirds of which is tail. The body and tail musculature are pink with small, scattered melanophores; the fins are unpigmented. Except for a bare upper lip, the oral disc has a single row of large marginal papillae; the jaw sheaths are slender and serrate, and the LTRF is $2/3$.

***Physalaemus petersi* (Jiménez de la Espada) (Plate 1H)**

Identification: Males 28–32 mm, females 32–36 mm. The skin on the dorsum has numerous small, red or orange tubercles that contrast with the dull brown ground color. The smooth belly is white or pale gray with bold black mottling. The throat and chest are gray, usually with a narrow, median cream fine line; the groin is pale orange with large black spots. The body is rotund; the snout is short and pointed, and the tympanum is evident. Parotoid glands and elliptical glands on the flanks are present. Neither the fingers or toes are webbed; lateral fringes are absent on the digits. The first finger is longer than the second, and males have a large, median, subgular vocal sac and nuptial pads on the thumbs.. The iris is dull bronze.

Similar species: *Edalorhina perezii* also has a tuberculate dorsum, an orange groin, and black and white venter, but it has a depressed body, conical tubercles on the eyelid, and white throat. Toads (*Bufo*) have granular skin on the belly.

Natural history: This nocturnal frog feeds exclusively on termites on the forest floor. Breeding occurs in ponds, where males call while floating in the water. The call consists of two notes—"dooing-wraack." Amplectant pairs kick up hemispherical foam nests that contain about 300 small, unpigmented eggs. Tadpoles attain lengths of 26 mm, of which about 60% is tail; the lower lip is devoid of papillae. The jaw sheaths are robust and serrate, and the LTRF is 2(2)/3. The body and tail musculature are black with cream flecks on the tail; the fins are gray.

***Pseudopaludicola ceratophyes* Rivero and Serna (Plate 8G)**

Identification: Females about 13 mm. The body is broad, and the head is narrow with a pointed snout and a long, conical process at the edge of each upper eyelid. The skin on the dorsum is smooth with scattered tubercles, especially prominent on the hind limbs and posterior part of the body, and an H-shaped dermal fold in the scapular region. The fingers are unwebbed, and the toes are long and about one-third webbed; the tips of the digits bear slightly expanded, flattened discs. The dorsum is tan or pale gray with the posterior part dark gray or brown; the flanks are black, and narrow dark bars are present on the lips and limbs. The venter is creamy gray, and the iris is pale bronze.

Similar species: The conical eyelid process is unique among small frogs in the region. The only other frogs having such processes are the much larger *Ceratophrys cornuta* and the three species of *Hemiphractus*, all of which have large, broad heads and different coloration.

Natural history: Little is known about the biology of this minute frog that inhabits primary forest. It has been observed to be active by day on the ground near water. Gravid females contain numerous small, pigmented eggs; presumably, like other members of the genus, it deposits eggs in shallow water and has aquatic tadpoles.

***Vanzolinius discodactylus* (Boulenger) (Plate 10I)**

Identification: Males 28–35 mm, females 32–35 mm. The body is moderately robust, and the snout is rounded. The dorsum is smooth with scattered, small, conical tubercles. The first finger is longer than the second, and the toes have basal webbing and lateral fringes. The digits terminate in slightly expanded, round discs that have 3–5 longitudinal grooves on the dorsal surfaces. Males lack nuptial pads or spines on the thumbs. The dorsum is dark brown, and the flanks are paler, usually with a gray or red tinge, with large dark brown spots on the flank and in the groin. The head is marked by cream bars on the lips and between the eyes. The posterior surfaces of the thighs are dark brown. The throat is dark brown or gray with cream flecks, and the

belly is cream with brown flecks laterally. The iris is bronze with brown reticulations.

Similar species: This species is most easily confused with the larger *Leptodactylus wagneri*, in which the digits terminate in rounded, unexpanded tips, and the venter is cream mottled with brown or black. The smaller *Adenomera* has the first and second fingers equal in length, no fringes on the toes, and a creamy white throat and belly.

Natural history: This species is active by day and night, especially after rains, in swampy areas in the forest. Males call from secluded places—natural depressions, under leaves and roots, at edges of logs—at the margin of the water; the call is a series of notes, “wheet-wheet-wheet.” About 150–420 unpigmented eggs are deposited in a foam nest at the edge of the water. Tadpoles attain a length of 25 mm. The body is brown with white flecks ventrally, and the tail is dull brown.

NARROW-MOUTHED FROGS (FAMILY MICROHYLIDAE)

Amazonian microhylids have small heads with a pointed snout and small eyes, robust bodies with short limbs, and smooth skin; a tympanum is absent in most species. Most microhylids are explosive breeders and deposit numerous small, pigmented eggs in water; the tadpoles have terminal oral discs without labial teeth and jaw sheaths. Microhylids are nocturnal and terrestrial; most species feed only on ants, but their foraging strategy differs from that of the diurnal dendrobatids; microhylids seek out columns of ants and sit in one place to feed.

Chiasmocleis anatipes Walker and Duellman (Plate 12E)

Identification: Males 18–20 mm, females 25–30 mm. The toes are fully webbed. The dorsum is olive green to dull brown with green and/or gold metallic flecks; the throat is gray with black mottling, and the belly and ventral surfaces of the hind limbs are white with bold brown mottling. The iris is reddish brown.

Similar species: The only other microhylid in the region with extensively webbed toes is the larger *Ctenophryne geayi*, which has a tan dorsum and dark brown venter with white flecks.

Natural history: This nocturnal species is found on the ground or on leaves of low herbs in primary forest. Breeding occurs in shallow, temporary ponds. The call is a short buzz. Tadpoles attain lengths of 33 mm, 70% of which is tail. The snout is rounded, and the eyes are lateral. The tail musculature is slender and tapers gradually to a pointed tip beyond the terminus of the fins, which are highest at midlength of the tail and about twice the height of the musculature. The body is olive tan above and yellowish white below.

Chiasmocleis bassleri Dunn (Plate 12F)

Identification: Males 17–22 mm, females 20–28 mm. The toes are webbed only basally. The dorsum and flanks are brown with a cream canthal and postorbital stripe; the forearms and stripes on the anterior surfaces of the thighs are pale orange. A large black spot is present in the groin. The throat and chest are gray with white flecks, and the belly and ventral surfaces of the hind limbs are bluish white with large black spots. The iris is bronze with minute black flecks.

Similar species: Among other microhylids in the region, *Chiasmocleis anatipes* and *Ctenophryne geayi* have extensive webbing between the toes. *Chiasmocleis ventrimaculata* has a white throat and venter with many small black spots, and *Hamptophryne boliviana* has a tan dorsum, sharply delineated from dark brown flanks.

Natural history: Terrestrial and fossorial, this frog usually is observed on the ground in primary forest at night.

Chiasmocleis ventrimaculata (Andersson) (Plate 12G)

Identification: Males 20–23 mm, females 21–24 mm. The toes are only webbed basally. The dorsum and flanks are dark olive brown to dull gray with minute gold to bluish white flecks. The venter is white with irregular black spots, and the iris is reddish brown.

Similar species: Among other microhylids in the region, *Chiasmocleis anatipes* and *Ctenophryne geayi* have extensive webbing between the toes. *Chiasmocleis bassleri* has a gray throat and chest with white flecks and bluish white belly and ventral surfaces of the hind limbs with large black spots; *Hamptophryne boliviana* has a tan dorsum, sharply delineated from dark brown flanks.

Natural history: This nocturnal, terrestrial frog occurs in primary forest. After heavy rains, males congregate to call while floating on forest ponds; the call is a series of short buzzlike notes. Clutches of 222–248 eggs, 2 mm in diameter, are deposited as a film on the surface of the pond. Tadpoles are gray with a blunt snout and lateral eyes. At least in southern Peru, these small frogs apparently exist mutualistically with tarantulas in the burrows inhabited by the spiders. The frogs feed on ants that may feed on tarantula eggs in the burrow. At night the frogs can be seen sitting between the legs of tarantulas at the mouths of their burrows; in such a position, the frogs are safe from most predators. How tarantulas, which commonly feed on frogs, recognize this species of microhylid remains a mystery.

Ctenophryne geayi Mocquard (Plate 12A)

Identification: Males 32–43 mm, females 42–55 mm. The body is robust

and depressed, and the toes are about four-fifths webbed. The dorsum is tan to pale brown with a cream middorsal line and minute cream flecks. The dorsal color, which is continuous onto the forelimbs, is delineated by a narrow creamy white line from the dark brown flanks and hidden surfaces of the hind limbs. The venter is dark brown with white flecks, and the iris is grayish bronze.

Similar species: The only other microhylid in the region with extensively webbed toes is the smaller *Chiasmocleis anatipes*, which has bold brown mottling on a white venter.

Natural history: A nocturnal and fossorial inhabitant of primary forest, *Ctenophryne* congregate at temporary ponds for breeding. Males call from under leaf-litter at the edges of ponds; the call consists on a long, low-pitched trill. Clutches of 520–610 eggs, about 2 mm in diameter, are laid in shallow depressions next to ponds. Tadpoles hatch in about 36 hours and remain suspended from the water surface for about 12 hours, after which they swim horizontally. The body is rounded with a broad, bluntly rounded snout and large, lateral eyes; the upper lip is fleshy, and nearly covers the opening of the oral disc. The tip of the tail is rounded; the dorsal fin is about twice as high as the ventral fin and higher than the musculature. The body and tail are pale brown with darker brown markings dorsally and laterally.

Hamptophryne boliviana (Parker) (Plate 12B)

Identification: Males 34–39 mm, females 39–44 mm. The body is moderately robust; the fingers and toes have distinct terminal discs and lack lateral fringes and webbing. The dorsum is tan with a large brown middorsal blotch and usually a faint creamy white middorsal stripe. The flanks, side of the head, and hidden surfaces of the limbs are dark brown. The throat is dark brown in males, and the belly and ventral surfaces of the hind limbs are creamy white with brown spots or reticulations. The iris is pale bronze with fine black reticulations.

Similar species: This species is most easily confused with the larger *Ctenophryne geayi*, in which the toes are four-fifths webbed, the dorsal coloration is continuous onto the forelimb (separated by dark brown in *Hamptophryne*), and the venter is dark brown with white flecks.

Natural history: This nocturnal frog inhabits primary and secondary forest, where they feed on columns of ants on the ground or on trunks and branches of trees to 1.5 m above the ground. Males congregate around shallow temporary ponds and call continuously after heavy rains, especially at the beginning of the rainy season. The call is a long “waaaah.” Clutches of 182–280 pigmented eggs, 1.5 mm in diameter, are deposited in water. Tadpoles attain lengths of about 30 mm, of which about 65% is tail. The body is de-

pressed, about twice as wide as high, with a bluntly rounded snout and laterally directed eyes. The tail fins are equal in height to one another and to the musculature; the fins extend to the pointed tip of the tail. The dorsum and throat are dark brown; the belly is gray with black mottling, and a white stripe is present laterally on the proximal one third of the tail.

Syncope antenori Walker (Plate 12C)

Identification: Males 11–12 mm, females 13–14 mm. The body is robust, and the snout is truncate; the tympanum is distinct and about one-half the size of the eye. There are only three fingers and four toes, which lack webbing and terminate in small discs. The dorsum is dull brown, and the venter is grayish brown with small bluish white flecks.

Similar species: The distinct tympanum and absence of large white spots on the venter distinguish this species from *Syncope carvalhoi*, which also has only three fingers and four toes. Other small frogs in the region having greatly shortened fingers and toes are *Adelophryne adistola* and *Phyllonastes myrmecoides*, which have digits terminating in asymmetrical tips or small papillae, respectively.

Natural history: An inhabitant of primary forest, this diminutive frog is found on the ground or low herbaceous vegetation at night. Females contain 5 or 6 unpigmented eggs 1.2 mm in diameter. Eggs are deposited in bromeliads; nonfeeding tadpoles having total lengths of 10–14 mm lack keratinized mouth parts.

Syncope carvalhoi Nelson (Plate 12 D)

Identification: Males 9–10 mm, females 10–11 mm. The body is robust, and the snout is truncate; only the ventral edge of the tympanum is visible. There are only three fingers and four toes, which lack webbing and terminate in small discs. The dorsum and venter are brown, and there are white spots on the venter.

Similar species: The absence of a distinct tympanum and presence of large white spots on the venter distinguish this species from *Syncope antenori*, which also has only three fingers and four toes. Other small frogs in the region having greatly shortened fingers and toes are *Adelophryne adistola* and *Phyllonastes myrmecoides*, which have digits terminating in asymmetrical tips or small papillae, respectively.

Natural history: This small frog inhabits leaf-litter on the forest floor. Females contain 5–8 unpigmented eggs 2.2 mm in diameter. Eggs are deposited in the water-filled axils of elephant-ear plants, where the tadpoles develop. Tadpoles attain lengths of 15.7 mm and are white with scattered melanophores. Recently metamorphosed young are black and about 5 mm long.

AQUATIC FROGS (FAMILY PIPIDAE)

Pipids are completely aquatic frogs with large, fully webbed feet. Most species, including the commonly used laboratory frog, *Xenopus laevis*, are African, but seven species, all in the genus *Pipa* occur in South America. Their greatly depressed heads and bodies and peculiarly modified hands distinguish them from all other frogs.

Pipa pipa (Linnaeus) (Plate 12I)

Identification: Males 106–154 mm, females 105–171 mm. The body is depressed; the head is broad, triangular, and flat with a pointed snout with a protruding dermal flap. The skin on the dorsum is tuberculate. The toes are fully webbed, and the unwebbed fingers terminate in bifurcate lobes. The dorsum is tan, usually with darker brown blotches; the venter is tan with darker brown blotches and a dark T-shaped mark with the transverse part on the chest.

Similar species: The only other *Pipa* in the region is *Pipa snethlageae*, which differs by lacking the dermal flap on the upper lip and by having simple, instead of bifurcate lobes on the ends of the fingers. The only other aquatic frogs with fully webbed feet in the region are *Hydrolaetare schmidtii* and *Rana palmipes*, both of which have normal finger tips and typically frog-shaped heads and bodies.

Natural history: These frogs inhabit ponds and swamps and seldom venture onto land, where they move clumsily. Males call from underwater; the call is a series of clicks. Males clasp females around the waist, and the pair swims in vertical circles as the female exudes eggs that are swept onto her back by the male's feet. About 80 unpigmented eggs about 6 mm in diameter imbed in the skin on the back of the female; in about 15 weeks, the skin ruptures above each embedded egg capsule, and small frogs emerge. Adults feed primarily on fish.

Pipa snethlageae Müller (Plate 12J)

Identification: Females 66–92 mm. The body is depressed; the head is broad, triangular, and flat with a pointed snout. The skin on the dorsum is roughened. The toes are fully webbed, and the unwebbed fingers terminate in simple lobes. The dorsum is gray or brown with darker brown or gray mottling; the venter is tan or gray with brown or dark gray spots or mottling. A bold dark mark extends from the eye to the angle of the jaw.

Similar species: The only other *Pipa* in the region is *Pipa pipa*, which differs by having a dermal flap on the upper lip and bifurcate, instead of simple, lobes on the fingers. The only other aquatic frogs with fully webbed feet in the region are *Hydrolaetare schmidtii* and *Rana palmipes*, both of which have

normal finger tips and typically frog-shaped heads and bodies.

Natural history: Little is known about this species, which presumably reproduces in the same manner as *Pipa pipa*.

POND FROGS (FAMILY RANIDAE)

In the Amazon Basin, there is only one species of this widespread family of frogs so familiar to most Europeans and North Americans.

Rana palmipes Spix (Plate 12H)

Identification: Males 55–104 mm, females 78–126 mm. The skin on the dorsum and venter is smooth; a dorsolateral dermal fold is present. The snout is pointed, and the distinct tympanum is almost as large as the eye. The first finger is longer than the second, and the digits terminate in narrowly rounded tips; the fingers lack webbing, and the toes are nearly fully webbed. The dorsum is green to olive tan, usually with small brown or black spots on the body and transverse bars on the limbs. The flanks are tan with dark brown spots, and the posterior surfaces of the thighs are black with creamy yellow reticulations. The venter is creamy yellow with a gray suffusion on the throat and black flecks on the belly and undersides of the hind limbs. The iris is reddish brown with a bright bronze cast dorsally.

Similar species: The only other large frog in the region having fully webbed feet and lacking large discs on the digits is *Hydrolaetare schmidtii*, in which the venter is creamy yellow with bold brown reticulations or spots and the dorsum has a large middorsal brown blotch. The large species of *Leptodactylus* having dorsolateral folds have no more than basal webbing between the toes.

Natural history: This forest inhabitant is active by day and night near ponds, lakes, and slow-moving streams. Males call from shallow water; the call is a series of guttural chuckling sounds. Clutches of as many 6750 small, pigmented eggs are deposited in clumps in the water. Tadpoles attain lengths of 92 mm, of which 60% is tail. The body is ovoid with a bluntly rounded snout and moderately large eyes directed laterally. The dorsal and ventral fins are about equal in height and terminate in a rounded tip. The oral disc is directed anteroventrally. The median part of the upper lip is bare, and the median part of the lower lip has one row of papillae; two rows of papillae fringe the disc laterally. The jaw sheaths are robust and finely serrate; the LTRF is 3(2–3)/4(1). The body is greenish brown mottled with dark brown dorsally; the belly is cream with gray spots, and the tail is orange-tan.

SELECTED REFERENCES

- DUELLMAN, W. E. 1978. The biology of an equatorial herpetofauna in Amazonian Ecuador. *Mus. Nat. Hist. Univ. Kansas Misc. Publ.* 65:1–352.
- A thorough study of the amphibians and reptiles of Santa Cecilia, Ecuador with keys to identification, ecological analyses, and many illustrations, some in color.
- DUELLMAN, W. E. 1988. Patterns of species diversity in neotropical anurans. *Ann. Missouri Bot. Gard.* 75:97–104.
- An analysis of occurrence, habitat utilization, and reproductive modes of frogs at 48 sites in Central and South America.
- DUELLMAN, W. E. 1990. Herpetofaunas in neotropical rainforests: comparative composition, history, and resource use. Pp. 455–555 in A. H. Gentry (ed.), *Four Neotropical Rainforests*. New Haven: Yale University Press, 627 pp.
- Comparison of amphibian and reptile faunas among three sites in the Amazon Basin and two in Central America.
- DUELLMAN, W. E. 1992. Reproductive strategies of frogs. *Scientific American* 267:80–87.
- A review of diverse reproductive modes in frogs; many color photographs.
- DUELLMAN, W. E., AND L. TRUEB. 1994. *Biology of Amphibians*. Baltimore: Johns Hopkins University Press, 670 pp.
- The pre-eminent reference and text on all aspects of amphibian biology, including their life history, ecology, and evolution; copiously illustrated with original drawings and photographs.
- HERO, J.-M. 1990. An illustrated key to the tadpoles occurring in the central Amazon rainforest, Manaus, Amazonas, Brasil. *Amazoniana* 11:201–262.
- Descriptions and illustrations of tadpoles of 52 species of frogs with ecological notes.
- HÖDL, W. 1990. Reproductive diversity in Amazonian lowland frogs. *Fort. Zool.* 38:41–60.
- A review of the different reproductive strategies of frogs in the Amazon Basin with many illustrations of mating and egg clutches.
- RODRÍGUEZ, L. O. 1992. Structure et organisation du peuplement d'anoures de Cocha Cashu, Parc National Manu, Amazonie Péruvienne. *Rev. Ecol. (Terre Vie)* 47:151–197.

An analysis of the abundance and ecological distribution of a community of frogs in terra firme and floodplain forest in south-eastern Peru.

- RODRÍGUEZ, L. O., AND J. E. CADLE. 1990. A preliminary overview of the herpetofauna of Cocha Cashu, Manu National Park, Peru. Pp. 410–425 in A. H. Gentry (ed.), *Four Neotropical Rainforests*. New Haven: Yale University Press, 627 pp.

An analysis of the occurrence and ecological distribution of amphibians and reptiles at one site in Manu National Park, Madre de Dios, Peru.

PLATES 1-12

PLATE 1
TOADS AND TOADLIKE FROGS

- A. *Bufo dapsilis* (p. 13), $\times 0.5$ (WWL). Note low cranial crests and orange flanks.
- B. *Bufo glaberrimus* (p. 13), $\times 0.6$ (JDL). Note smooth skin and absence of cranial crests; *B. dapsilis* has a fleshy, protruding snout.
- C. *Bufo ceratophrys* (p. 12), $\times 0.5$ (JHM). Note eyelid processes.
- D. *Bufo typhonius* complex (p. 14), $\times 0.6$ (WWL). Note expanded cranial crests in this large female; many individuals have a middorsal yellow or tan stripe.
- E. *Bufo marinus* (p. 14), $\times 0.3$ (WED). Note large parotoid gland.
- F. *Atelopus spumarius* (p. 12), natural size (WWL). Note dorsal color pattern; the belly is pale yellow with black marks, and the palms and soles are bright orange.
- G. *Dendrophryniscus minutus* (p. 15), $\times 2$ (WED). Note pointed snout and spiculate skin.
- H. *Physalaemus petersi* (p. 71), natural size (WED). Note that groin is black bordered by orange; the throat and chest are dark gray with a median white line.
- I. *Ischnocnema quixensis* (p. 63), $\times 0.8$ (WED). Note tuberculate dorsum and knoblike ends of digits.
- J. *Ceratophrys cornuta* (p. 52), $\times 0.5$ (WED). Note huge head and eyelid processes.

A



B



C



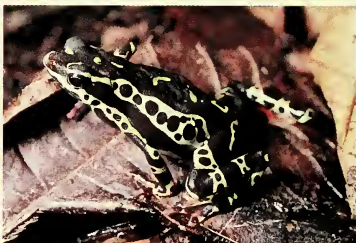
D



E



F



G



H



I



J



PLATE 2
DENDROBATIDS AND MIMICS

- A.** *Colostethus marchesianus* (p. 16), $\times 2$ (WED). Note dorsolateral tan stripe.
- B.** *Edalorhina perezii* (p. 65), natural size (WED). Note tubercles on eyelids and depressed body.
- C.** *Dendrobates ventrimaculatus* (p. 17), $\times 2$ (WED). Note pattern of stripes; yellow color phase.
- D.** *Dendrobates ventrimaculatus* (p. 17), $\times 2$ (WED). Note pattern of stripes; orange color phase.
- E.** *Epipedobates parvulus* (p. 19), $\times 2$ (WED). Note granular dorsum and absence of lateral white stripe.
- F.** *Epipedobates zaparo* (p. 20), $\times 2$ (WED). Note granular dorsum and presence of lateral white stripe.
- G.** *Epipedobates hahneli* (p. 18), $\times 2$ (JHM). Note absence of pale lateral stripe; blue venter is visible.
- H.** *Epipedobates trivittatus* (p. 19), natural size (WED). Note pattern of stripes.
- I.** *Epipedobates femoralis* (p. 17), $\times 1.5$ (WED). Note ventrolateral stripe and red spot on thigh.
- J.** *Lithodytes lineatus* (p. 71), $\times 0.8$ (WED). Note red spots on thigh and absence of ventrolateral stripe.

A



B



C



D



E



F



G



H



I



J



PLATE 3
SMALL TREEFROGS

- A.** *Hyla allenorum* (p. 23), $\times 2$ (WED).
Note white lateral stripe; belly is blue and black.
- B.** *Hyla miyatai* (p. 34), $\times 2.5$ (WED).
Note red markings on dorsum; venter is pink.
- C.** *Hyla rhodopepla* (p. 35), $\times 1.5$ (WED).
Note broad, brown lateral stripe; venter is white.
- D.** *Hyla minuta* (p. 33), $\times 2$ (WED). Note cream stripe on heel and unmarked lip.
- E.** *Hyla brevifrons* (p. 25), $\times 2$ (WED).
Note two cream bars below eye; pale spots are present on thigh and venter is white.
- F.** *Hyla parviceps* (p. 34), $\times 2$ (WED).
This frog has single cream bar below eye and orange spot on ventral surfaces of shank.
- G.** *Hyla koechlini* (p. 29), $\times 2$ (WED).
Note black flanks and hidden surfaces of thighs.
- H.** *Hyla leali* (p. 30), $\times 2$ (WED). Note single pale bar below eye; usually there is an X-shaped mark on dorsum.
- I.** *Hyla riveroi* (p. 36), $\times 2$ (WED). Note three pale bars on lip.
- J.** *Hyla rossalleni* (p. 37), $\times 2$ (WED).
Note absence of pale spots below eye and dorsal pattern.

A



B



C



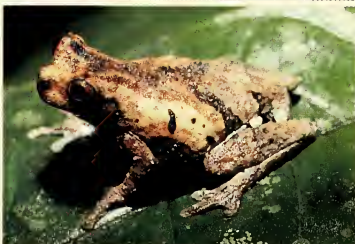
D



E



F



G



H



I



J



PLATE 4
MEDIUM-SIZED TREEFROGS

- A. *Hyla leucophyllata* (p. 31), $\times 1.5$ (WED).
Note orange webbing and pale bars on shanks.
- B. *Hyla leucophyllata* (p. 31), $\times 2$ (WED).
Some individuals have this zebra-like pattern on the dorsum.
- C. *Hyla bifurca* (p. 23), $\times 1.5$ (WWL).
Note orange webbing and absence of pale bars on shanks.
- D. *Hyla sarayacuensis* (p. 37), natural size (WED). Note irregular edges of pale markings.
- E. *Hyla triangulum* (p. 38), natural size (JDL). Note red webbing; dorsal pattern varies from being plain to having many rounded spots.
- F. *Hyla triangulum* (p. 38), natural size (WED). Note red webbing; this is an example of the many-spotted phase of this frog.
- G. *Hyla calcarata* (p. 26), $\times 0.75$ (WED).
Note large calcar and black bars on flanks and thighs.
- H. *Hyla fasciata* (p. 26), $\times 0.75$ (WED).
Note small tubercle on heel and irregular black spots on flanks and thighs.
- I. *Hyla microderma* (p. 32), natural size (WWL). Note yellow discs on digits.
- J. *Hyla haraldschultzi* (p. 29), $\times 2$ (WWL).
Note slender body and longitudinal markings.

A



B



C



D



E



F



G



H



I



J



PLATE 6
LEAF FROGS

- A.** *Agalychnis craspedopus* (p. 43), $\times 0.8$ (AY). Note flank pattern and scalloped folds on limbs.
- B.** *Phyllomedusa atelopoides* (p. 44), natural size (WED). Note green flecks on dorsum.
- C.** *Phyllomedusa palliata* (p. 45), natural size (WED). Note tan side of head and flanks.
- D.** *Phyllomedusa tomopterna* (p. 46), $\times 0.8$ (WED). Note orange and black on flanks and hidden surfaces of limbs, and calcar on heel.
- E.** *Phyllomedusa tarsius* (p. 45), $\times 0.5$ (WED). Note iris color and elongate parotoid gland.
- F.** *Phyllomedusa tarsius* (p. 45), $\times 0.5$ (WED). Note pale spots on flanks.
- G.** *Phyllomedusa bicolor* (p. 44), $\times 0.3$ (WWL). Note huge parotoid gland and eye color.
- H.** *Phyllomedusa bicolor* (p. 44), $\times 0.3$ (WED). Note pattern on flanks and hidden surfaces of limbs.
- I.** *Phyllomedusa vaillanti* (p. 46), $\times 0.5$ (WED). Note angular parotoid gland with row of white tubercles.
- J.** *Phyllomedusa vaillanti* (p. 46), $\times 0.5$ (WED). Note color of eye and groin.

A



B



C



D



E



F



G



H



I



J



PLATE 7
VARIOUS TREEFROGS

- A.** *Hyla granosa* (p. 28), natural size (WED). Note granular dorsum and color of iris.
- B.** *Hyla punctata* (p. 35), natural size (JHM). Note red dorsolateral stripe and marks on dorsum; this can change to a white dorsolateral stripe with or without distinct red dots on dorsum.
- C.** *Scinax cruentomma* (p. 48), $\times 1.3$ (WED). Note red streak in iris; hidden surfaces of hind limbs are pale brown.
- D.** *Scinax rubra* (p. 50), natural size (WED). Note pale dorsolateral stripe; groin and hidden surfaces of thighs are mottled black and deep yellow.
- E.** *Scinax funerea* (p. 48), $\times 1.3$ (WED). Note mottled dorsum; posterior surfaces of thighs are brown.
- F.** *Scinax garbei* (p. 49), natural size (WED). Note pointed snout, and red and black bars on thighs.
- G.** *Scarthyla ostinodactyla* (p. 47), $\times 2$ (JHM). Note lateral stripes; feet are fully webbed.
- H.** *Sphaenorhynchus carneus* (p. 51), $\times 2$ (WED). Note reddish dorsolateral stripe and spots on dorsum.
- I.** *Sphaenorhynchus dorisae* (p. 51), natural size (WWL). Note pale spots on dorsum and absence of canthal stripe; dermal flaps are present on either side of the cloacal opening.
- J.** *Sphaenorhynchus lacteus* (p. 51), $\times 0.8$ (JHM). Note canthal stripe and dermal flaps on either side of cloacal opening.

A



B



C



D



E



F



G



H



I



J



PLATE 8
SOME TREEFROGS AND OTHER FROGS

- A.** *Phrynohyas coriacea* (p. 41), $\times 0.7$ (WED). Note large black spot above insertion of arm.
- B.** *Phrynohyas resinificatrix* (p. 42), $\times 0.7$ (LOR). Note large tubercles on dorsum.
- C.** *Phrynohyas venulosa* (p. 42), $\times 0.5$ (WED). Note narrow white labial stripe and absence of large tubercles on dorsum.
- D.** *Hemiphractus johnsoni* (p. 21), $\times 0.8$ (WWL). Note process on tip of snout, protruding triangular head, and expanded discs on digits.
- E.** *Hemiphractus proboscideus* (p. 21), $\times 0.8$ (WWL). Note elongate process on tip of snout, protruding triangular head, and expanded discs on digits.
- F.** *Hemiphractus scutatus* (p. 22), $\times 0.7$ (RWM). Note massive head and narrow discs on digits.
- G.** *Pseudopaludicola ceratophyes* (p. 72), $\times 3$ (WED). Note conical tubercle on eyelid.
- H.** *Adenomera andreae* (p. 64), $\times 1.5$ (WED). Note dark triangular mark on head; venter is white.
- I.** *Adelophryne adiastrata* (p. 53), $\times 3$ (WWL). Note short digits; venter is black with cream spots.
- J.** *Phyllonastes myrmecoides* (p. 63), $\times 3$ (WWL). Note short digits; a prominent tubercle is present on ventral edge of tarsus.

A



B



C



D



E



F



G



H



I



J



PLATE 9
ELEUTHERODACTYLUS

- A.** *Eleutherodactylus altamazonicus* (p. 55), natural size (RWM). Note tubercles on dorsum, black and red in groin, and absence of tympanum.
- B.** *Eleutherodactylus martiae* (p. 59), $\times 2$ (WED). Note tubercles on dorsum, and absence of tympanum and red or yellow in groin.
- C.** *Eleutherodactylus ockendeni* (p. 60), $\times 1.5$ (WED). Note primarily smooth dorsum and small tubercle on eyelid; posterior surfaces of thighs are brown to rose-red.
- D.** *Eleutherodactylus ventrimarmoratus* (p. 62), natural size (JHM). Note low tubercles on dorsum and absence of tympanum; posterior surfaces of thighs and venter are white with black mottling.
- E.** *Eleutherodactylus lacrimosus* (p. 57), $\times 2$ (JDL). Note finely granular dorsum and absence of bars on lips.
- F.** *Eleutherodactylus carvalhoi* (p. 55), $\times 2$ (WED). Note tuberculate dorsum and yellow mark in groin.
- G.** *Eleutherodactylus acuminatus* (p. 54), $\times 2$ (WWL). Note dark canthal and lateral stripes.
- H.** *Eleutherodactylus lythroides* (p. 58), $\times 2$ (CWM). A distinct tympanum is present; venter is black and red.
- I.** *Eleutherodactylus sulcatus* (p. 61), natural size (WWL). Note ridges on dorsum and broad head; large cream spots are present in groin and on posterior surfaces of thighs.
- J.** *Eleutherodactylus diadematus* (p. 56), natural size (WWL). Note red iris; diagonal black and cream marks are present on posterior part of flanks.

A



B



C



D



E



F



G



H



I



J



PLATE 10

ELEUTHERODACTYLUS AND OTHER LEPTODACTYLIDS

- A. *Eleutherodactylus lanthanites* (p. 57), natural size (WED). Note conical tubercle on heel and pale lip; throat is gray with median white stripe.
- B. *Eleutherodactylus conspicillatus* (p. 56), natural size (WWL). Note absence of tubercle on heel; posterior surfaces of thighs are dark brown with small, red dots and venter is white.
- C. *Eleutherodactylus peruvianus* (p. 60), natural size (WED). Note dorsolateral folds and pale lip; posterior surfaces of thighs are brown with small, red spots, and throat and chest are cream with dark flecks.
- D. *Eleutherodactylus malkini* (p. 58), natural size (WED). Note bars on lips and absence of tubercle on heel; posterior surfaces of thighs are brown with greenish-yellow flecks.
- E. *Eleutherodactylus vilarsi* (p. 62), natural size (JDL). Note pale lip and absence of tubercle on heel; posterior surface of thigh is brown and venter is uniform gray.
- F. *Eleutherodactylus nigrovittatus* (p. 59), $\times 2$ (WED). Note pointed tips of digits; there is a large, brown spot in groin, and venter is gray with white flecks.
- G. *Eleutherodactylus variabilis* (p. 61), $\times 2$ (JDL). Note smooth dorsum and large, yellow spot in the groin.
- H. *Eleutherodactylus variabilis* (p. 61), $\times 2$ (JDL). Many individuals have a bright middorsal stripe.
- I. *Vanzolinius discodactylus* (p. 72), $\times 1.5$ (WED). Note conical tubercles on dorsum and small, expanded discs on digits; throat is gray.
- J. *Hydrolaetare schmidtii* (p. 65), $\times 0.4$ (WED). Note dorsally directed eyes, large tympanum, and fully webbed feet; belly is yellow with bold, black mottling.

A



B



C



D



E



F



G



H



I



J



PLATE 11
LEPTODACTYLUS

- A.** *Leptodactylus bolivianus* (p. 66), $\times 0.4$ (WED). Note dorsolateral folds; posterior surfaces of thighs are mottled cream and dark brown.
- B.** *Leptodactylus mystaceus* (p. 67), natural size (LAC). Note dorsolateral folds and white labial stripe; cream longitudinal stripe on distal part of posterior surface of thigh.
- C.** *Leptodactylus knudseni* (p. 66), $\times 0.3$ (WH). Note marks on lip and pair of dorsolateral folds.
- D.** *Leptodactylus knudseni* (p. 66), natural size (WWL). Juveniles have a distinctive color pattern.
- E.** *Leptodactylus rhodomystax* (p. 68), $\times 0.5$ (WWL). Note pale lip and heavy dorsolateral fold; throat is gray.
- F.** *Leptodactylus rhodomystax* (p. 68), natural size (WWL). Note black and cream posterior surface of thigh.
- G.** *Leptodactylus stenodema* (p. 69), $\times 0.5$ (WWL). Note large head and smooth dorsum; posterior surfaces of thighs are black.
- H.** *Leptodactylus pentadactylus* (p. 68), $\times 0.3$ (WED). Note long dorsolateral folds and bars on lips.
- I.** *Leptodactylus rhodonotus* (p. 69), $\times 0.5$ (WED). Note tubercles on dorsum; posterior surfaces of thighs are cream with black spots or mottling.
- J.** *Leptodactylus wagneri* (p. 70), $\times 0.7$ (WED). Note dermal ridges on body; venter is creamy white with gray mottling.

A



B



C



D



E



F



G



H



I



J



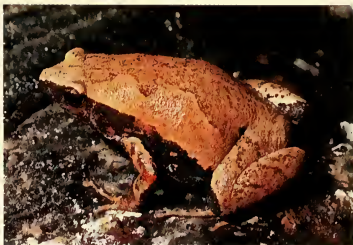
PLATE 12
NARROW-MOUTHED AND AQUATIC FROGS

- A.** *Ctenophryne geayi* (p. 74), natural size (WED). Note pale dorsal coloration continuous onto arm.
- B.** *Hamptophryne boliviana* (p. 75), natural size (WED). Note dark lateral color separating pale dorsum from arm.
- C.** *Syncope antenori* (p. 76), $\times 3$ (WWL). Note reduced digits and distinct tympanum; belly is gray with bluish-white flecks.
- D.** *Syncope carvalhoi* (p. 76), $\times 3$ (WWL). Note reduced digits and absence of distinct tympanum; belly is dark with large, cream spots.
- E.** *Chiasmocleis anatipes* (p. 73), $\times 2$ (WED). Feet are fully webbed and venter is white with black mottling.
- F.** *Chiasmocleis bassleri* (p. 74), $\times 2$ (WED). Note pale arms; venter is bluish white with large, black spots.
- G.** *Chiasmocleis ventrimaculata* (p. 74), $\times 2$ (WED). Note dark arms; venter is white with small, black spots.
- H.** *Rana palmipes* (p. 78), $\times 0.4$ (WED). Note dorsolateral fold, large tympanum, and fully webbed feet; belly is creamy yellow with small, black spots.
- I.** *Pipa pipa* (p. 77), $\times 0.3$ (WED). Note depressed body, triangular head, and fully webbed feet; a large, black cross-shaped mark is present on chest, and lobes on tips of fingers are bifurcate.
- J.** *Pipa snethlageae* (p. 77), $\times 0.5$ (WWL). Note depressed body, triangular head, and fully webbed feet; there is no cross-shaped mark on chest, and tips of toes have simple lobes.

A



B



C



D



E



F



G



H



I



J



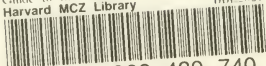
Herp

QL668.E2 R53 1994

Guide to the frogs of the Iquitos r

Harvard MCZ Library

RBF2021



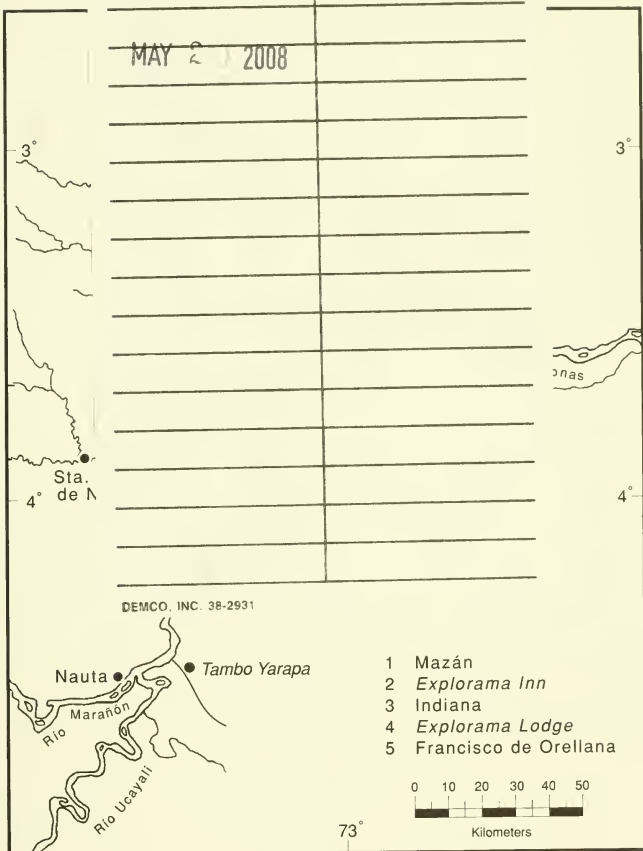
3 2044 062 439 740

~~NEW~~

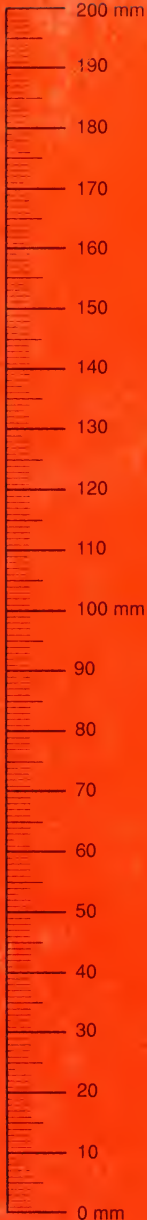
DATE DUE

JUN 07 1995 pen. with H.E.P. pub

MAY 2 2008



Map of the Iquitos region in Amazonian Peru, showing major rivers, towns and villages, and tourist lodges (in italics).



THE diversity of plants and animals in the upper Amazon Basin, especially in Peru and Ecuador, is greater than anywhere else on earth, but this astonishingly rich ecosystem is imperiled by human devastation—habitat destruction, hunting and pollution. Only by making the populace of the entire world aware of this awesome biological crisis can much of the remaining biotic diversity and the fragile ecosystem be saved. This is absolutely essential if humans are to live in harmony with the tropical rainforest, an environment that offers many sustainable uses.

In order to understand the rainforest and its potential benefits to us, it is necessary to know the kinds of plants and animals that live there, how they interact with one another, and how they contribute to the complex ecosystem. This guide to the frogs of the Iquitos region is the first in an anticipated series of such guides dealing with the plants and animals of the region.

The Guide to the Frogs of the Iquitos Region, Amazonian Peru is intended to introduce the amateur naturalist and the professional biologist to the highly diverse frog fauna of the region. Accounts of 112 species provide information on the characteristics and natural history of these amphibians; 111 species are illustrated in color.